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The Trying Times During Readjustment

The men in supervisory capacities on American railroads are being put to a test by what may be considered not necessarily a period of reconstruction, but the result of conditions occasioned by the war. The manner in which these men meet these new problems will show the stuff they are made of. We all well appreciate how the conditions have changed, we all know also that certain changes must come if railroading is to be conducted along economic lines. It is the broad and far-sighted man who sees in these present conditions a swing of the pendulum towards the reactionary and who will foresee its return swing towards more stable and logical conditions. The war has wrought changes in old-time methods of railroading, which, under ordinary circumstances, would have taken years to bring about. Some of these changes have come to stay, others have not. We must take the good from what has come and learn our lessons from the bad. It is no time to give way to discouragements nor to have a spirit of hopelessness. We all must realize that what is fundamentally wrong will eventually be corrected, and everyone must put his shoulder to the wheel to correct the wrong and to further that which is right. Form your own conclusions as to what is right and best and have the courage of your convictions.

Give More Attention to Lumber

In buying steel, the railroads specify within the narrow limits the allowable percentage of impurities and the physical properties required and tests are conducted to insure that the material meets the specifications. Lumber, on the other hand, is usually bought without any precautions being taken to insure that it will have the necessary strength and lasting power, although the properties of different specimens from the same species of wood may vary widely considering the large sums the railroads spend for lumber for use in cars, the scant attention that has been given to its selection and to methods of getting the maximum service from the material is remarkable.

Often-times some of the common practices in purchasing lumber that have been in effect for years, can profitably be changed. For example, one road has found it advisable to specify No. 1 common for sills, even though it is necessary to cull out almost one-third of the material and use it for sill splices, draft timbers, etc. The same road has also found that by reducing the customary allowance of one-half inch for finishing on sills, side plates and other long timber, about eight per cent is saved. These instances will serve to show that a consideration of the methods of buying timber now in use may reveal possibilities for effecting considerable savings.

Coaling Stations Affect Fuel Consumption

The conservation of fuel is a matter that on most roads is handled by the mechanical department. It is probably due to this fact that the greatest attention is paid to methods of saving through improvements in the motive power, while the preparation of the coal and the operation of the fuel stations receive only passing consideration. The importance of the proper operation of fuel stations in securing the economical use of coal, was strikingly brought out at a recent meeting of the Western Railway Club by J. G. Crawford, who presented data to show that if the plants were improperly operated, as much as six per cent of the fuel might be wasted.

To secure the best grade of fuel for locomotive service as delivered on the tender, the coal loaded at the mine must be

checked to insure that the lump and screenings are well mixed, the metal bottoms of the coal pockets must be kept bright, and each pocket must be completely emptied every few days. If these precautions are observed, the engines will receive a fairly uniform grade of well cracked mine run coal. On the other hand, if the chute pockets are not cleaned thoroughly and systematically, the metal bottoms will become rusty, and coal will accumulate, with the result that some engines will receive egg coal, others cracked mine run, and still others screenings.

The fuel performance under the latter conditions will not be as good as if the engines had received a uniform grade of mine run coal. Tests conducted at the University of Illinois, show that two inch lump coal is 98 per cent as efficient as mine run, and that two inch screenings are 90 per cent as efficient as mine run. It would make no difference whether the two inch lump and two inch screenings were obtained by screening mine run at the mine or whether they resulted through separation of mine run at the coaling station., Therefore, under the first assumed condition, the efficiency of the coaling station would be 100 per cent, and under the second condition, assuming that the engines received one-half the time two inch lump, and the other half, two inch screenings, the efficiency would be only 94 per cent, or the average of 98 and 90 per cent. The amount to be saved by closer supervision of coaling stations will not average six per cent, but nevertheless on most roads it will be found to be a very appreciable item. There are other conditions that make it advisable to give close attention to the coaling plants. There will be more delay to trains and more engine failures where some locomotives receive all lump coal and others all screenings, than if each engine received a uniform grade. Furthermore, the gradual oxidation of accumulations of mine coal which have remained in the chute undisturbed for some time may cause fires due to spontaneous combustion.

Wages of Railway Shop Employees

The New York State Department of Labor issues regularly a bulletin reviewing the labor situation in the shops and factories of the state. A statement of the average weekly earnings in December, 1918, in representative New York state factories, including all employees in both office and shop, indicates that employees in car, locomotive and railway repair shops are among the very best paid shop employees in the state. In December, 1918, their average weekly earnings amounted to $34.07 as compared to an average of $23.18 for 55 industries. Only one other class of employees, those engaged in the manufacture of pig iron and rolling mill products, received a higher weekly wage; these employees earned $37.97 a week. Employees in the boat and ship building establishments received an average weekly wage of $32.01 and those employed in structural and architectural iron work $30.21.

It is of special interest to compare the conditions in December, 1918, with those of December, 1914. In December, 1914, the average weekly earnings for employees in car, locomotive and railway repair shops was $14.34. Employees in 11 other industries received higher wages. For instance, employees in factories making beverages received $18.58; miscellaneous stone and metal products, $18.47; automobiles, carriages and airplanes, $18.07; printing and book making, $17.03; pig iron and rolling mill products, $16.63; boat and ship building, $16.16; structural and architectural iron work, $15.31; flour, feed and other cereal products, $15.10; slaughtering, meat packing and dairy products, $14.88; drugs and chemicals, $14.57; paints, dyes and colors, $14.43. The average of the 55 industries under consideration was $12.56.

In 1915 the railroad shop employees averaged $16.21 per week and were outranked by nine other industries, the average weekly earnings for the 55 industries being $13.49. In December, 1916, the average earnings for the railroad shop employees jumped to $19.28 as compared with an average of $15.51 for the 55 industries. The railroad shop employees were outranked by only three other industries, the best paid workers being those making pig iron and rolling mill products who received an average weekly wage of $21.76. In December, 1917, the railway shop employees advanced to an average weekly earning of $23.10 and, as in 1918, were outranked by only one other industry—pig iron and rolling mill products. The average weekly earnings for the 55 industries in December, 1917, was $17.71.

Doubtless the contrast between the wages received by railroad shop employees and employees in other industries is still more marked in other parts of the country where competition for labor is not so great. The rates for railroad shop employees have been standardized throughout the country and there are undoubtedly many districts where these employees rank as the very highest paid employees in any industry. It would be interesting to know to what extent this is appreciated by the railroad shop employees themselves, and whether they are giving adequate returns for the wages received. If not, energetic measures should be taken to see that they are thoroughly instructed in their tasks and sufficient supervision should be provided to insure a full day's work for a full day's pay. The public generally has watched closely the increased wages given to railroad employees, and it will look to these employees and their officers for increased efficiency and service.

Piecework Being Abolished in Railway Shops

One of the last acts of Director General McAdoo was to issue an order instructing the railroads to have the shopmen vote as to whether piecework should be retained and that the policy of the shops in this respect should be governed by the will of "a substantial majority." Having at the beginning of 1918 given the trade unions entree on all railroads to develop their organizations, and later encouraging them by increasing the hourly wage without granting a corresponding increase in the piecework rate, the results of this ballot could easily be predicted. There is probably today no railway shop operating under the piecework system. If there is we should be very glad to know about it. The New York Central System, on which the piecework system had been successfully operated both from the standpoint of the men as well as the road, has discarded it entirely. The employees on other large systems likewise have ruled piecework out of existence.

There is not a reader of this paper but will appreciate what the discontinuance of piecework means to output and the cost of repairs. After the increases of Supplement No. 4 to General Order No. 27 removed the incentive for the men to work piecework some very interesting data were obtained. One road found that the output was but 60 per cent. as much per man as before the supplement went into effect and 40 per cent. as much work was being turned out per dollar as before. Another road making a comparison of the last three months of 1917 with the corresponding period in 1918 found a decrease of 28.5 per cent. in the car department in the actual earnings of the men based on the piecework rates in effect in 1917. On still another road the average actual piecework earnings of a labor committee man dropped from 59 cents in March, 1918, to 24 cents in October of the same year, for which he received 58 cents. This gives an indication of what has been done in decreasing the output by not giving the piecework rates the same consideration that the hourly rates received.

The economic value of a man to the world at large is governed primarily by three things; namely, the time he devotes to increasing the world's wealth, the diligence with which he does his work during that time and his cleverness in per-

forming it. Under the hourly rate only one of these qualifications is required of the worker—that is, the time he puts into his occupation. Piecework on the other hand not only demands the time of the workman but provides an incentive for diligent work performed in a skilful and able manner. Fundamentally, therefore, we cannot expect as large an output under day work as we might expect under piecework. The incentive for increasing the output of a man, which has been removed by the abolition of piecework, can to some extent be reclaimed by an increase in the supervision, and where labor is plentiful, by the process of elimination and reorganization for the purpose of getting the best men and the most diligent workers in the shop. The piecework system was so generally used in the shops of the railroads, particularly in the car department, that the reorganization and re-education of the supervising forces is necessary. It is this feature that requires the most careful thought by the railway managements today. Under the existing conditions the workmanship of the men must not only be carefully watched, but it will be necessary to see that they give a full day's work for a full day's pay. There is no use crying over spilled milk. We all must make the best of conditions as they exist and the successful man is he who adjusts himself to those conditions and makes the most of them. Pitch in therefore, recognize the task ahead of you and for your own self respect meet it and make the most of it.

Dissatisfaction with Wage Increases

Several anonymous letters have been sent to the *Railway Mechanical Engineer* by our readers commenting on the injustices that have been occasioned by the various wage orders promulgated by Mr. McAdoo during his year's tenure of office as director general of railroads. In practically every case these letters appear to contain true facts, but we cannot use them as it is against the policy of this publication to print anonymous communications in its columns. We know there are injustices, many of them, but injustices must be expected when any attempt is made to solve, along theoretical lines, the question of the compensation of railroad labor as it existed in 1917. The large amount of overtime worked last year and the varying retroactive periods for different classes accentuated the inequalities in readjustments. The supervising forces were, to use the "doughboy" expression, "out of luck," and many of them when the shops are working 10 hours a day will be still "out of luck," but on an eight-hour day basis there will be comparatively few instances where the remuneration of the supervising forces will be out of proportion to the mechanic. For instance, at 68 cents an hour a mechanic working eight hours a day, six days a week, will average $141.44 per month. The gang foreman at a rate of 73 cents an hour will receive $152 per month. This compares very favorably with the rates paid other foremen, these ranging anywhere from $215 to $350 a month. There are some glaring inconsistencies, however, on some roads, in the case of the roundhouse foremen. The men, receiving 68 cents an hour, are required to work only eight hours, while the foremen receiving between $250 and $275 per month are required to work 12 hours. In the case of an average wage of $265 per month, the foremen will actually be working at an hourly rate, based on overtime after eight hours, less than the mechanics under them Every one will appreciate the importance of the roundhouse foremen's duties and the "grief" they have to bear. It takes a particularly good man to handle the job. Where are the railroads going to get these men if such discriminations are allowed to exist?

The application of the back pay, extending back to January 1, for the workmen, and July 1, for the supervising foremen, has caused the greatest dissatisfaction. In one instance which was brought to our attention the operator of a wrecking train crane received a total income for 1918 of over $4,000, which, of course, was caused by the excessive overtime he put in during that year. His foreman received less than $3,000 for the same period, and if the same overtime obtains during 1919 the crane man will still exceed his foreman. In another case a traveling crane operator handling a crane over seven pits drew $1,100 back pay, while as a general rule foremen received less than half that amount, and so it goes, according to the varying retroactive periods. Take the car inspector: Formerly, at 35 cents an hour, with a 12-hour day and seven days a week, he would average $127 per month. With his increase to 58 cents and for the same working period he received $246 a month, but now with eight-hour shifts he receives an average of $140 a month, an increase of $13 a month.

While it thus seems that the supervising shop forces are pretty well taken care of on an eight-hour day basis, except possibly in the case of some local discrepancy, it would seem from what we have been able to determine that the master mechanics have not been, perhaps, treated as kindly. The importance of their position should not be underestimated. They bear the responsibility of providing power in proper condition for the operation of the trains. By their most loyal support and work was the excellent record of moving trains accomplished last year. They have a difficult and trying position to fill, acting as the intermediary between the mechanical and transportation departments and between the officers and the men. It is by their efforts and tact that interdepartmental relations are properly maintained. It is true that they have not organized as have the shop men and many of the foremen, but that should not stand in the way of their proper recognition.

Present Condition of Freight Cars

While the general statistics available have shown a gradual improvement in the bad order car situation, they do not reflect the actual condition of the freight cars in this country. In fact, it has been stated that freight cars are in a very bad condition. The good record in the number of cars in bad order is due primarily to the fact that during the past year every effort has been made to keep the cars running and, to gain this end, repairs have been made which might come under the head of temporary repairs. Those cars requiring heavy repairs have been neglected and allowed to accumulate. In addition to this many cars reported in good order should be in the repair shop receiving a general overhauling. This hand-to-mouth policy has been carried on for so long that a vast amount of work is now required to build up the available freight car mileage to what it was when the Railroad Administration took over the roads over a year ago.

With the cars distributed all over the country without regard to ownership, as was the case last year, it has been impossible to maintain them in as good condition as formerly. With the railroads in the hands of private owners and with the car service rules such that cars reached their home roads more often, it was possible for the home roads to make improvements and properly repair their cars. Foreign roads without the necessary repair parts are obliged to a certain extent to make make-shift repairs in order to keep the cars moving, and it is not to be expected that the cars will be maintained as well as when they are on the home roads.

H. L. Shipman, equipment inspector of the Santa Fe, in a paper before the Western Railway Club recently stated that formerly there was a normal percentage of from 35 to 40 per cent of the box cars on the home lines, whereas at the present time this percentage has fallen as low as from 7 to 12 per cent. On one particular road in the east this same tendency has been noticed, but the figures are not quite as good. For three years prior to government opera-

tion that road maintained an average of 52 per cent home cars on its lines, whereas under federal control the average was only 14 per cent. During the same three-year period cars repaired were distributed about equally between home and foreign cars. During 1918 under government control only 22 per cent of the cars repaired were home cars and 78 per cent were foreign cars. This is the chief reason for the cars being in such poor condition.

The problem now is to get the cars home as quickly as possible in order that they may be given proper attention and repaired according to the standards of the owning lines. It is quite important that this be done, not only from the standpoint of the condition of the cars but from the standpoint of the government itself, for, according to law, it is responsible for returning the roads to their owners in as good condition as when they were received. Where $50 to $75 has been spent on the cars in order to get them off the repair track, only to become bad order again within a week or two, anywhere from $400 to $500 must be spent to put these cars back into first-class condition. The wear and tear on the cars has been very hard during the past year because of the congested condition of the railroads and the haste with which the cars passed through classification yards. Charges of careless practices in switching have frequently been made and an enormous amount of damage has been caused by such practices, all of which must be repaired before the car situation will be what it should be. Every effort should be made to correct such practices.

The Railroad Administration realizes the necessity of getting the cars home for proper attention as is indicated by Car Service Section Circular CS-53, which permits the short-routing of cars home, and further by Circular No. 27, recently issued by W. T. Tyler, director of the Division of Operation, which states that the present conditions with respect to car supply present an opportunity for a relocation of equipment more in accord with ownership than has been practicable during war conditions, under which each unit has been used with the sole purpose of meeting the then existing traffic demands, and further, for providing for the return to the owning road when desired for rebuilding or application of betterments, cars which can be put in safe condition for movement at reasonable cost. With these corrective measures taken it is now up to the individual roads to get the cars home and repair them. With the great reduction in traffic requirements and with the availability of cars for repairs, every measure should be taken to repair them. There should be no retrenchment in the purchase of material nor in the working hours of the shop until the car situation has materially improved.

NEW BOOKS

The Starrett Data Book for Machinists. By H. P. Fairfield, J. N. Bethel, H. H. Edge and J. C. Spence, collaborating editors. 177 pages, illustrated, 4½ in. by 7 in., bound in leather. Published by the L. S. Starrett Company, Athol, Mass. Price 50 cents.

As the title of this book implies, it is a compilation of data regarding machine shop practice and the materials of manufacture, arranged in convenient tabular form, to enable the machinist to finish work with a greater degree of efficiency and accuracy. The information is complete and covers a wide range of work and materials used, as well as weights, measurements, speeds, etc. Measuring instruments are illustrated and their uses described. It was the aim of the publishers to make the book of the greatest value to the largest possible number of practical machinists throughout the country, and the four editors were selected not only because of their knowledge of machine shop work, but because each represents a different field with its own peculiar problems and methods. Machinists should find the book of much assistance in their everyday work.

COMMUNICATIONS

INADEQUATE MAIN BOXES

To the Editor:

The one defect more than any other, that is knocking out the heavy power on the railroads of this country today is inadequate main boxes. The short sighted policy of equipping the heavy power with main boxes of the same weight, size and bearing as the rest of the driving boxes, has undoubtedly been a serious and costly mistake. I have seen locomotives just out of the repair shop, equipped with new machinery and driving boxes, develop a bad pound in their main boxes, due to worn shells, in less than four months, making it necessary to renew these boxes if it was desirable to keep locomotive in first class condition. You can not have a 100 per cent locomotive when equipped with defective main boxes. There can be no reasonable doubt, that if heavy freight locomotives were equipped with main boxes of a size, weight and bearing commensurate to the power developed in the cylinder of the locomotives, they would run as long without renewal as any other driving box. The loss in efficiency; the cutting out of the rod bushings; the strain on the entire locomotive as well as the cost of repairs, would seem to demand a more adequate main box. In fact, some roads have already begun to equip heavy power with heavier main boxes.

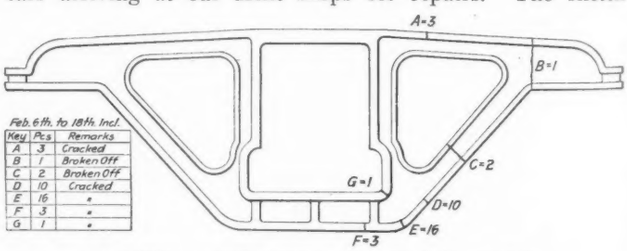
J. H. Buck.

SAFE LIMITS FOR WELDING TRUCK SIDE FRAMES

To the Editor:

The practice of electric welding car castings has become quite general on most railroads of this country during the past two or three years. There is no question as to the saving that can be effected by this process but there is a question as to how far we can safely go with the electric welding of car castings, especially truck sides and truck and body bolsters. Some roads are limiting the welding to cracks not over 1½ in. in depth, while other roads are welding truck frames, bolsters, etc., that have been entirely broken.

During the past few weeks a record has been kept of the truck frames that have been found cracked and broken under cars arriving at our Kent shops for repairs. The sketch



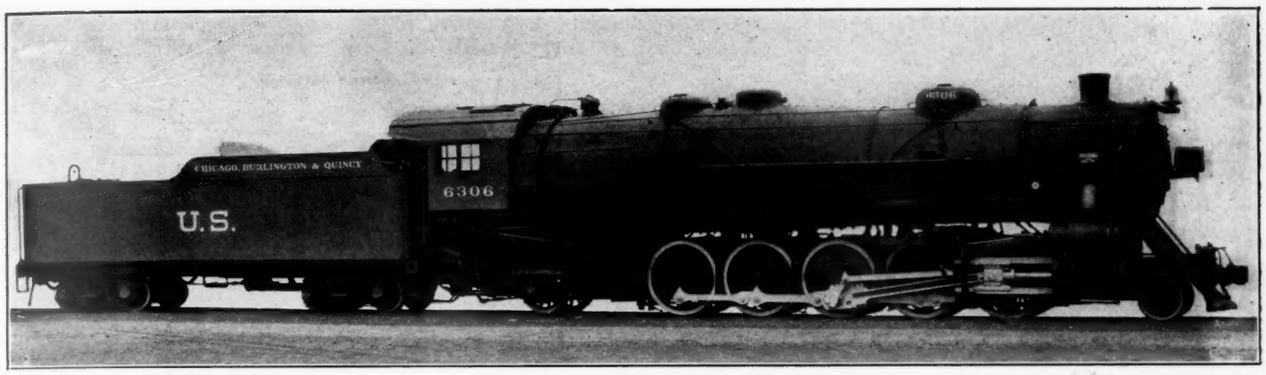
Feb. 6th. to 18th. Incl.

Key	Pcs.	Remarks
A	3	Cracked
B	1	Broken Off
C	2	Broken Off
D	10	Cracked
E	16	"
F	3	"
G	1	"

Location of Fractures in Truck Side Frames

shows the location of the fractures as found on these frames, covering a period of two weeks. A total of 36 frames were found either cracked or broken. The one frame cracked at point *B* had been previously electric welded; the workmanship on this weld had been improperly performed as the casting was not chipped before the welding was done, the welded metal being simply applied to the outside of the casting at the fracture. One of the frames which failed at point *C* had also been previously electric welded in a similar manner. The fractures on these frames varied from ½ in. to 2 in. deep. Only a few frames were found where the fracture extended into the web of the casting. It would be interesting to learn whether other roads have had similar trouble with welded side frames.

W. W. Warner.



STANDARD HEAVY 2-10-2 LOCOMOTIVE

Heaviest Administration Single Unit Type; Total Weight 380,000 lb., Tractive Effort 74,000 lb.

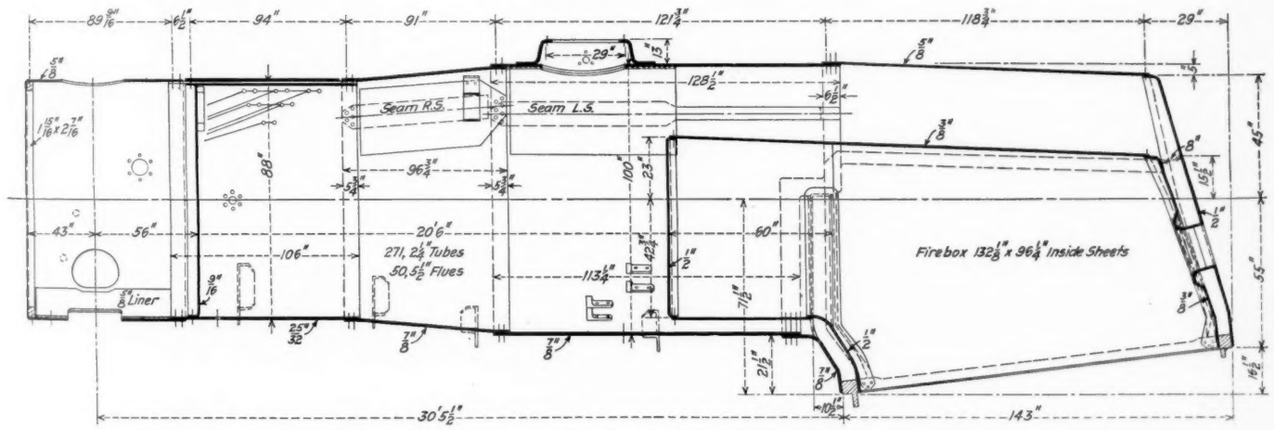
THE first locomotive of the Railroad Administration's standard heavy 2-10-2 type was recently completed at the Brooks Works of the American Locomotive Company for the Chicago, Burlington & Quincy. This locomotive was designed on the basis of driving axle loads of 60,000 lb. and has a total weight on drivers of 293,000 lb. The total weight of the locomotive in working order is 380,000 lb. and it is capable of exerting a calculated maximum tractive effort of 74,000 lb.

The design of this locomotive possesses no unusual features, the type of details throughout being similar to those used in the construction of other standard locomotives which already have been described. Interchangeability of parts between the various types has been effected wherever stresses and dimensions would permit. The relation of boiler capacity to the cylinder demand, calculated in accordance with Cole's ratios, shows ample boiler capacity both as to heating surface and grate area. The steam generating capacity is 104 per cent of the cylinder demand at a piston speed of 1,000 ft. per minute; the size of grate also shows up favorably, the ratio being 102.3 per cent.

As this is the heaviest single unit type of freight locomotive included among the Railroad Administration's standards it is of interest to compare it with a number of other heavy locomotives of the same type. By an inspection of the table it will be seen that it can by no means be ranked among the heaviest or most powerful 2-10-2 locomotives which have been built, although there have probably been none of better balanced design from the standpoint of boiler capacity.

The boiler barrel is of the telescopic type, with an outside diameter at the first course of 88 in., increasing to a maximum diameter of 100 in. There are three courses, the middle one of which is conical; the third course is 113¼ in. in length and the dome is located on this course.

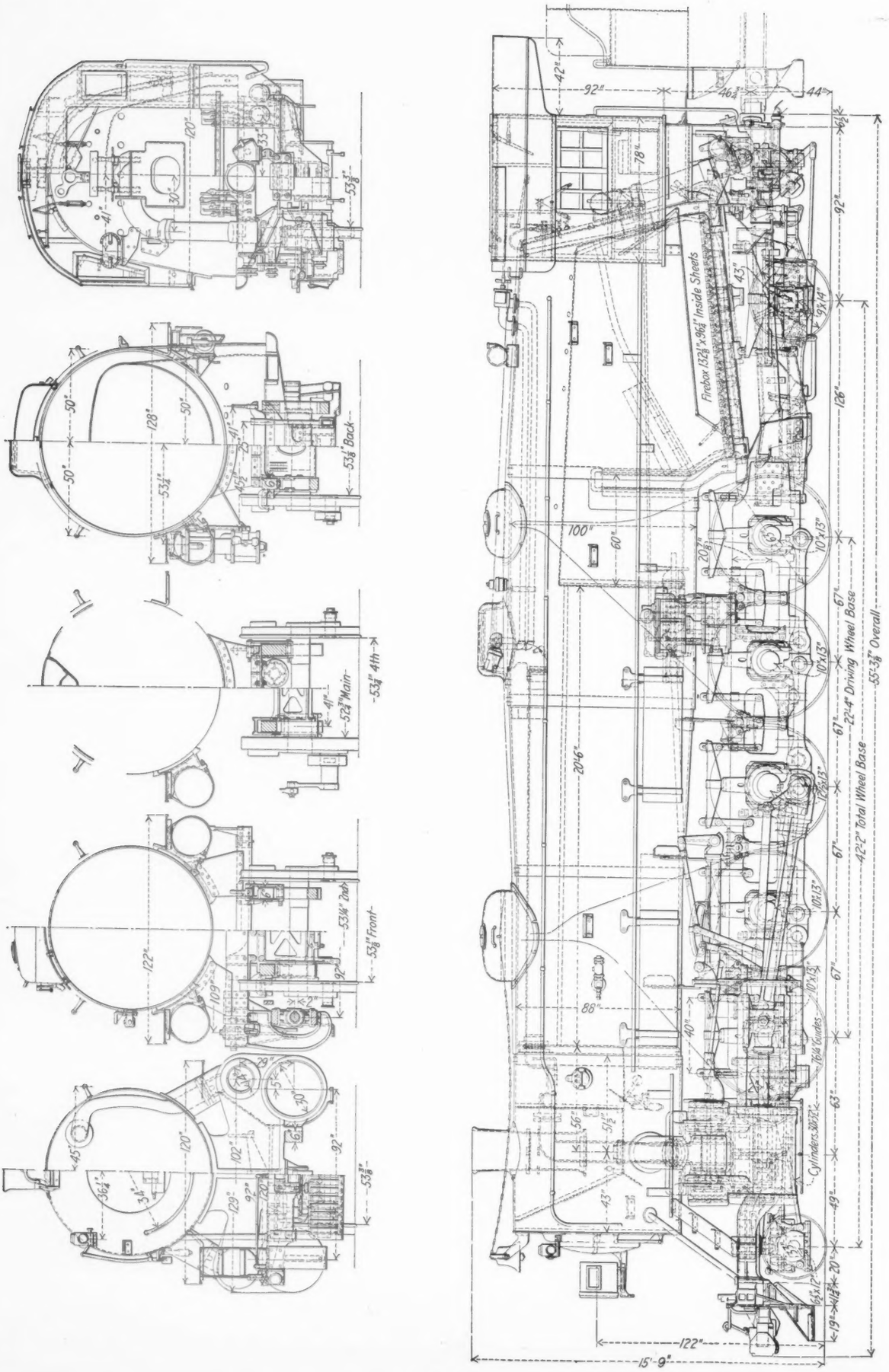
The firebox includes a barrel combustion chamber, the tube sheet of which is 60 in. ahead of the throat sheet, thus providing for tubes 20 ft. 6 in. in length. The firebox is fitted with a brick arch carried on five tubes and is fired by a Hanna mechanical stoker. Other equipment includes the Franklin butterfly firedoor and power gate shaker.



Longitudinal Section of the Standard Heavy 2-10-2 Type Boiler

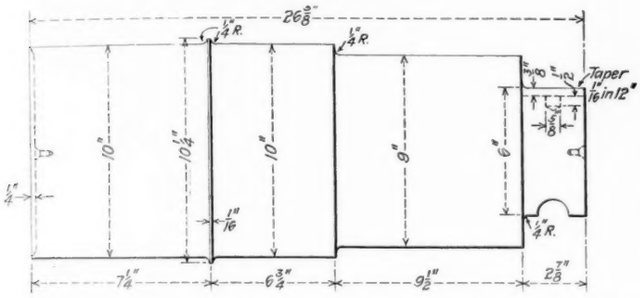
The tube sheet is laid out for 271, 2¼-in. tubes and 50, 5½-in. flues for a 50-unit type *A* superheater. The tubes are spaced ¾ in. apart while the flues are one inch apart.

The general features of the frame design are identical with those of other single unit standard locomotives. The cylinders are carried on a single front rail cast integral with the main frame, and a Commonwealth cradle casting is spliced to the main frames just back of the rear driving pedestals. The frames are six inches wide and have a maximum depth of top rail of 8⅜ in. over the pedestal jaws. The minimum depth of the top rail is seven inches. The maxi-



Elevation and Sections of the United States Railroad Administration Standard Heavy 2-10-2 Type Locomotive

mum and minimum depths of the lower rail are 5½ in. and 5 in., respectively. The front rail under the cylinders is six inches wide and tapers from a depth of 12¾ in. at the rear to 11½ in. at the front of the cylinder fit.



The Main Crank Pin for the Railroad Administration Heavy 2-10-2 Type Locomotive

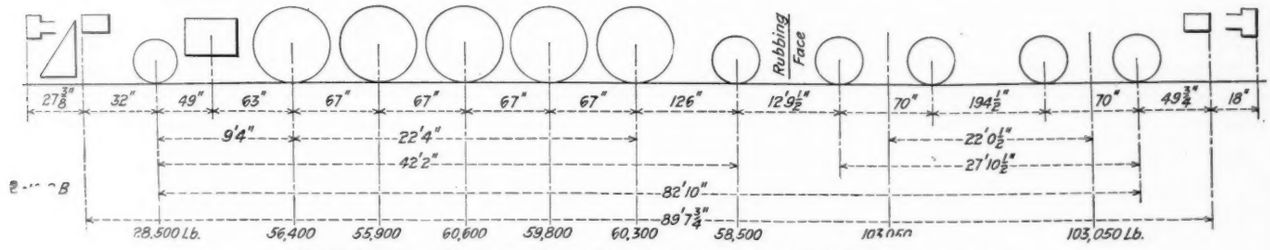
The driving axles have journals 10 in. in diameter by 13 in. in length with the exception of the main, the diameter of which is 12½ in. The axles and driving boxes having the 10-in. journals are interchangeable with those of the same journal size on other standard types of locomotives. This includes the light 2-10-2 type and both the light and heavy Mikado type locomotives. The drawing of the main crank pin illustrates the type of pin used in all the standard locomotive designs. The engine truck under these locomotives is of the constant resistance type and is identical with that used on the 2-6-6-2 Mallet type locomotive. A number of the engine truck details, including the center pin, pedestal, pedestal crosstie, swing bolster, swing frame and link are also identical with those used on the trucks of both Mikado type locomotives and the light Santa Fe type. With the exception of the radius bar these details are also used on the light Mallet locomotive.

The trailer truck is of the Cole-Scoville type and as a whole is not interchangeable with any other class of loco-

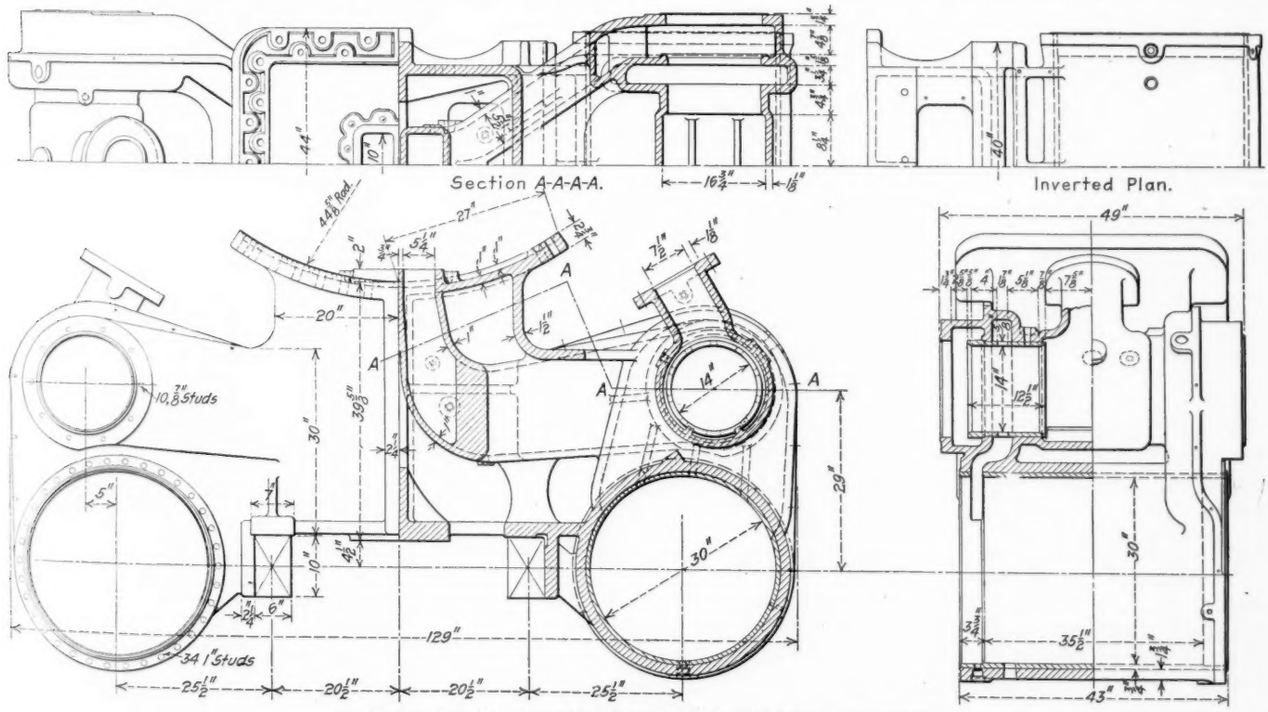
A COMPARISON OF HEAVY 2-10-2 TYPE LOCOMOTIVES

Road	U.S.Std.	Pa. Lines	D. & R. G.	Erie	N.Y.O. & W.
Year built	1918	1918	1916	1916	1916
Tractive effort, lb.	74,000	80,900	81,200	83,000	71,200
Total weight, lb.	380,000	435,400	428,500	401,000	353,500
Weight on drivers, lb.	293,000	351,300	337,500	335,500	298,500
Diameter of drivers, in.	63	62	63	63	57
Cylinder diameter and stroke in.	30x32	30x32	31x32	31x32	28x32
Steam pressure, lb. per sq. in.	190	205	195	200	190
Heating surface, total evap., sq. ft.	5,156	4,725	5,369	4,959	4,498
Heating surface, equivalent,* sq. ft.	7,001	7,152	7,362	6,870	6,009
Grate area, sq. ft.	88.2	80.0	88.0	94.8	80.2
Tractive effort x diam. drivers ÷ equiv. heating surface*	665.9	701.7	695.0	760.0	677.0
Firebox heating surface ÷ equiv. heating surface,* per cent	6.3	5.2	5.0	5.0	5.4
Grate area ÷ volume cylinders	3.3	3.1	3.2	3.4	3.5

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.



Wheel Loading Diagram of the Standard Heavy Santa Fe Type Locomotive

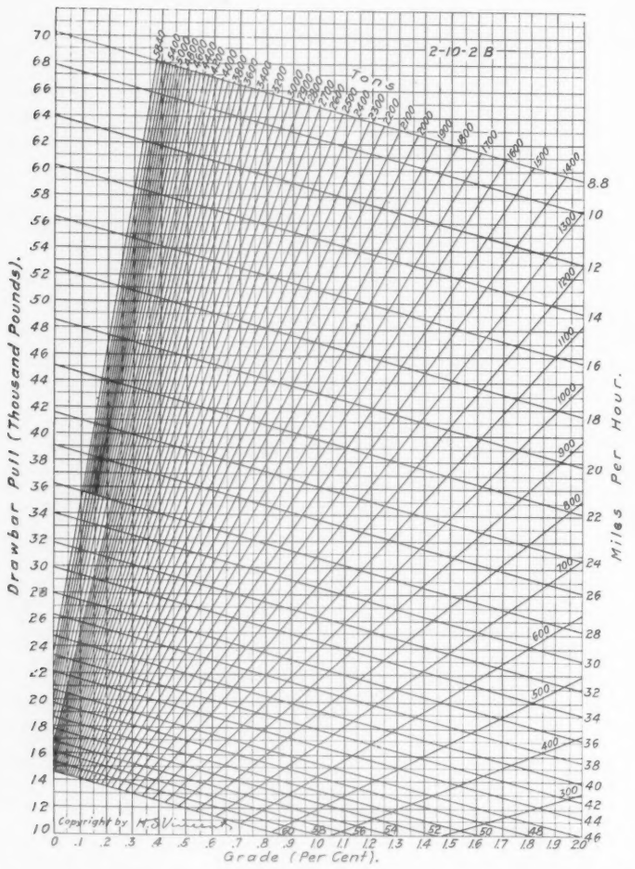


Cylinder for the Standard Heavy Santa Fe Type Locomotive

motives. The frame, however, is identical with that used under the light Santa Fe type, both Mikados and the light Mallet locomotives.

The cylinders are shown in detail in one of the illustrations, and are typical of those on the other classes of single unit type engines. They are 30 in. in diameter with a stroke of 32 in. and are fitted with pistons of single plate dished section similar in design to those used on all the standard locomotives. The valve chambers are designed for the use of 14-in. piston valves. As on the other standard locomotives Hunt-Spiller gun iron is used for cylinder and valve chamber bushings, piston and valve bull rings and packing rings, and crosshead shoes. The steam distribution of these locomotives is effected by the Southern valve gear and the locomotive is fitted with the Lewis power reverse gear.

Among the principal specialties with which these loco-



Tonnage Rating Chart Prepared for the Standard Heavy 2-10-2 Type Locomotive

motives are equipped are Chambers backhead type throttle, Ashton 3½-in. open safety valves, Hancock No. 13 nonlifting injectors, Everlasting blow-off cocks, Detroit six-feed lubricators, Barco flexible pipe joints and Radial buffers and Unit safety bar between the engine and tender.

The tonnage rating diagram was prepared and is copyrighted by H. S. Vincent. The curves of hauling capacity are constructed for a car resistance of four pounds per ton. The chart may be used for any other car resistances by converting them into terms of grade as follows:

1 lb. car resistance	=	.05 per cent grade
1 deg. curve uncompensated	=	.04 per cent grade

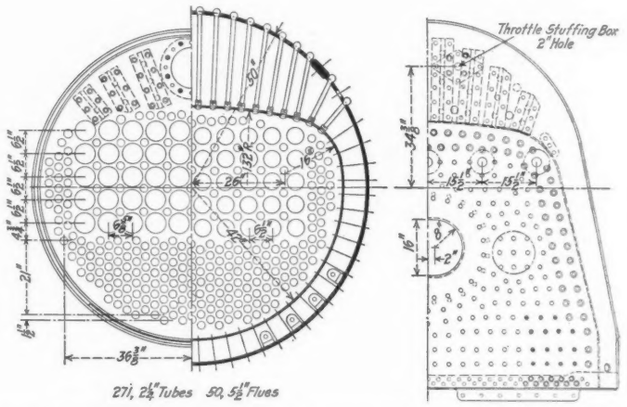
For example, find the tonnage capacity of the locomotive at 20 m. p. h. on .6 per cent grade combined with five-degree uncompensated curve and with a train resistance of five pounds per ton.

The combined resistance in terms of grade is:

.6 + (5 x .04) + (1 x .05) = .85 per cent.

At the intersection of the ordinate for .85 per cent grade with the drawbar pull curve for 20 m. p. h. we find 2,100 tons as the capacity of the engine.

The clearance and wheel loading diagrams were prepared in the office of F. P. Pfahler, chief mechanical engineer of the Division of Operation of the Railroad Administration.

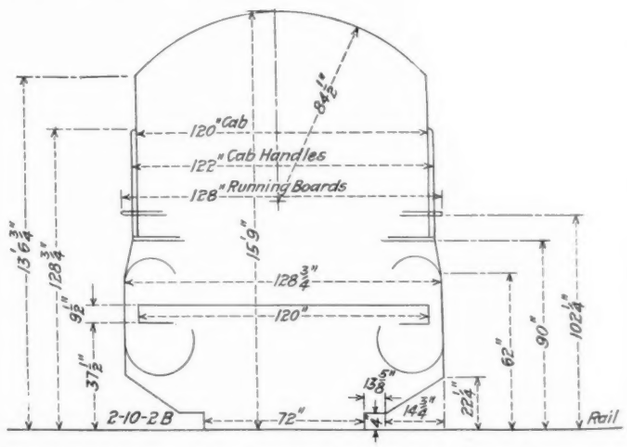


Half Elevations of the Back Boiler Head and Front Tube Sheet and Half Section Through the Combustion Chamber

The weights shown on the wheel loading diagram are actual. Other data and dimensions for this locomotive are as follows:

General Data

Gage	4 ft. 8½ in.
Service	Freight
Fuel	Bit. coal
Tractive effort	74,000 lb.
Weight in working order	380,000 lb.
Weight on drivers	293,000 lb.
Weight on leading truck	28,500 lb.
Weight on trailing truck	58,500 lb.



Clearance Diagram of the Standard Heavy 2-10-2 Type Locomotive

Weight of engine and tender in working order	586,100 lb.
Wheel base, driving	22 ft. 4 in.
Wheel base, total	42 ft. 2 in.
Wheel base, engine and tender	82 ft. 10½ in.

Ratios

Weight on drivers ÷ tractive effort	4.0
Total weight ÷ tractive effort	5.1
Tractive effort × diam. drivers ÷ equivalent heating surface*	665.9
Equivalent heating surface* ÷ grate area	79.4
Firebox heating surface ÷ equivalent heating surface,* per cent	6.1
Weight on drivers ÷ equivalent heating surface*	41.9
Total weight ÷ equivalent heating surface*	54.3
Volume both cylinders	26.4 cu. ft.
Equivalent heating surface* ÷ vol. cylinders	265.2
Grate area ÷ vol. cylinders	3.3

Cylinders

Kind	Simple
Diameter and stroke	30 in. by 32 in.

Valves

Kind	Piston
Diameter	14 in.
Greatest travel	7 in.
Steam lap	1⅛ in.
Exhaust clearance	Line and line
Lead in full gear	3/16 in.

Wheels

Driving diameter over tires	63 in.
Driving journals, main, diameter and length	12½ in. by 13 in.
Driving journals, others, diameter and length	16 in. by 13 in.
Engine truck wheels, diameter	33 in.
Engine truck, journals	6½ in. by 12 in.
Trailing truck wheels, diameter	43 in.
Trailing truck, journals	9 in. by 14 in.

Boiler

Style	Con. wagon top
Working pressure	190 lb. per sq. in.
Outside diameter of first ring	88 in.
Firebox, length and width	132⅛ in. by 96¼ in.
Firebox plates, thickness	Sides, back and crown ⅜ in.; tube, ½ in.
Firebox, water space	Sides and back, 5 in.; front, 6 in.
Tubes, number and outside diameter	271—2¼ in.
Flues, number and outside diameter	50—5½ in.
Tubes and flues, length	20 ft. 6 in.
Heating surface, tubes	3,258 sq. ft.
Heating surface, flues	1,469 sq. ft.
Heating surface, firebox	429 sq. ft.
Heating surface, total	5,156 sq. ft.
Superheater heating surface	1,230 sq. ft.
Equivalent heating surface*	7,001 sq. ft.
Grate area	88.2 sq. ft.

Tender

Tank	Water bottom
Frame	Cast steel
Weight	206,100 lb.
Wheels, diameter	33 in.
Journals, diameter and length	6 in. by 11 in.
Water capacity	12,000 gal.
Coal capacity	16 tons

*Equivalent heating surface = total evaporative heating surface + 1.5 times the superheating surface.

THE RESISTANCE OF MATERIALS

The Effect of Sudden or Abrupt Changes in the Section on the Distribution of the Unit Stresses

BY G. S. CHILES AND R. G. KELLEY

I

IN the testing of sample or test pieces of material for the purpose of determining its various properties such as tensile strength, etc., it has long been recognized by engineers that the actual stretch or extension of the test specimen as well as the value obtained for its ultimate strength is affected to a considerable extent by its general form or contour. It is also quite generally understood, that in pulling specimens in a testing machine, it is of prime importance to maintain a truly axial pull, since otherwise an undesirable bending stress is set up which affects to a greater or lesser degree the results obtained. These facts have become more in evidence as the use of the extensometer or strain gage has gradually become more extensive; two strain gages attached to the opposite sides of a test bar often exhibit a considerable variation in readings due to the presence of a bending stress.

As a general rule these facts have been recognized and accepted merely as a characteristic feature of the testing of materials and have not been taken into consideration or put into practical application to any great extent in the actual design and construction of members employed in engineering structures and machines. As a matter of fact, this time-honored practice of applying values determined from tests upon specimen bars whose form is such that they will offer the maximum resistance, to the design of actual details admits of more or less inaccuracy and may be entirely misleading as regards results desired, since the form which offers the maximum resistance can seldom be utilized. When, however, it is desired merely to make comparisons of the relative resistances of different materials, the employment of test bars of such form provides a convenient means of obtaining accurate data.

The object of this article is to review briefly some of the data relative to the effect of abrupt changes of section under "static" and "dynamic tests" which has already been presented by various authorities and also to submit the results of some additional experiments dealing with this phase of engineering science which were carried out by the writers. While these experiments were not performed with such a degree of exactness as to permit of the derivation of formulae or laws, it is hoped the results will contribute in some small degree to the store of information relative to this subject by visualizing the mechanics of stress distribution.

It is customary in designing members in which there are sudden or abrupt changes of section such as bars, plates, etc., having drilled or punched holes, threaded bolts, or members similar to those shown at *a*, *b* and *c* in Fig. 1, to employ as the working value of the fibre stress the value for the average fibre stress determined by dividing the axial load in pounds by the minimum cross-sectional area expressed in terms of square inches. This practice is based upon the assumption that the distribution of stress is uniform throughout the section. However, for values up to the elastic limit of the material, a point which is considered by some engineers to represent the maximum desired range of stress, the stress is not uniformly distributed over the cross section but is considerably greater at some points thereof than at others, especially at parts which embody a rapid change of form such as a cross section immediately adjacent to the edge of a hole or to a boss or a shank. This non-uniform distribution of stress also occurs in irregular, curved or abrupt sections or surfaces. Due to the fact that the intensity of the stress is greater at the edge of a restricted area, the material at that point will be stressed beyond its elastic limit at a lower value of the total load than would be the case were the change from the larger to the smaller section made more gradual and less abrupt.

EFFECT OF GENERAL FORM ON ULTIMATE STATIC STRENGTH

In the case of good test specimens of ductile materials, such as wrought iron and mild steel, the flow of metal preceding rupture and causing local contraction of section often extends longitudinally over a distance of from six to eight times the diameter or width of section. The process of failure under a static test is a gradual one due to the progressive breaking down of the material as the maximum stress is transmitted from point to point upon the yielding of the metal under the increasing load thrust upon it by the failure of the metal at some other part of the cross section to withstand the stress to which it is subjected. In the case of steel, the part of the cross section which is subjected to the greatest stress intensity will yield first, throwing a portion of its load upon the material in the remaining portions. As the particles successively fail the load upon the remaining particles is continually increased in amount and the process of fail-

ure gradually becomes accelerated. As, under similar conditions, the same action takes place in members other than test specimens, this explains why in some instances members in which the length of reduced sections are short as compared to the transverse dimensions require a greater load to cause failure under a static test than members having similar reduced sections which have a greater ratio of length to transverse dimensions. The process of metallic flow becomes more difficult as the length of the reduced section is shortened and, in general, the value of the breaking load is increased.

The importance of the size of the test piece has long been recognized and is usually specified so as to afford a fair comparison of results.

The foregoing will explain why it is desirable when convenient to specify that the form of the specimen bars which are to be submitted for static tests shall be such that the length of the test section is not less than from eight to ten times the greatest transverse dimension and, in the case of bars having enlarged ends, that the change of section shall not be abrupt. Although due consideration is usually given to the form of the specimen and the effect of its general form upon the values determined by the static test, these features are frequently disregarded in the actual design and fabrication of the various members which are to constitute the structure or the machine.

A common instance of this may be found in the case of riveted joints, where the metal left between the holes is usually subjected to tensile stress. It has actually been determined by experiment that the metal in these sections will support a greater load per square inch of cross-sectional area under static test than a full section elsewhere in the same specimen, which is of sufficient length to permit of free local flow. Kennedy in a report on riveted joints before the Institute of Mechanical Engineers * produced evidence to the effect that the tensile strength of a strip of mild steel plate in which a number of holes had been drilled might reach a value as high as 12 per cent greater than that of an undrilled strip. Where the holes are punched instead of drilled it appears that the remaining metal adjacent to the holes is greatly weakened. It is distorted and overstrained by the shearing action and is rendered less capable of plastic deformation due to the hardening effect of the overstrain.

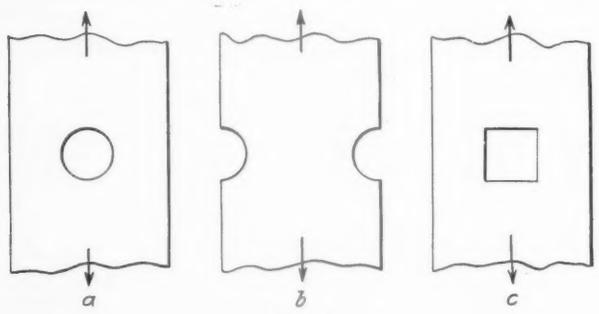


Fig. 1

The hardened portion thus receives an undue proportion of the stress and the strip will fail under a smaller load than it would were the stress uniformly distributed over the cross-section. This is a case of ductile and non-ductile material in the same cross-section.

The ultimate strength of members having irregular or abrupt sections under a static test becomes, then, in a measure a function of the ductility of the material. For non-ductile materials such, for example, as cast iron, fracture will occur at or near the minimum section as a result of the unequal distribution of stress. In the preceding discussion the two statements, "will support a greater load" and "will fail under a smaller load," it should be remembered, dealt respectively with ductile material which had not been overstrained, and with material which had been overstrained by punching the holes, thus acting more like non-ductile material. In the case of ductile materials, although the first deformation will take place at those localities where a restriction of sectional area occurs, *i. e.*, the edge of a hole, an edge adjacent to a boss, or an enlargement of sectional area, rupture under static test will be apt to occur at some cross-section other than that having the greatest stress, for the reason that at or near this cross-section the contraction

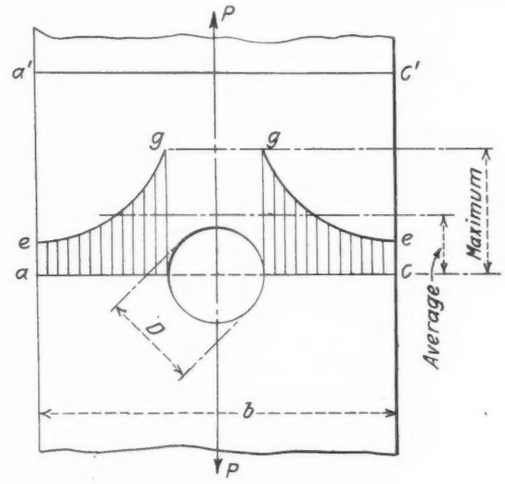


Fig. 2

of sectional area which precedes rupture is prevented to a considerable extent by the projecting sections of the member.

The tensile strength is reckoned on the original area of the test piece and not on the final area at the point of fracture. If we would term the tensile strength based upon the original area the nominal tensile strength and the real tensile strength the value obtained by using the area at the moment of fracture, then the difference between the nominal and the real tensile strength would depend upon the reduction in area. If we could prevent the test specimen from contracting, we would raise the nominal tensile strength and this is really what happens in a perforated bar or one having an abrupt change of section. Since only ductile materials have an appreciable contraction of area the above applies only to ductile material. In non-ductile or only slightly ductile material the perforated strip, when pulled in a testing machine, will usually break through the hole and the total pull will equal the product of the net area of the section by the tensile strength of the metal.

It should be remembered that the test pieces under discussion above have a non-uniform stress distribution due to their generally irregular or abrupt form. In the ductile material plastic deformation would take place and cause a uniform stress distribution but this is prevented or retarded by the irregular form. In the non-ductile material, there being practically no plasticity or local flow the stress distribution does not become uniformly distributed and the particles soon start to fail at the high stress point. This is more of a progressive break as explained above.

STATIC TESTS AND ACTUAL SERVICE TESTS

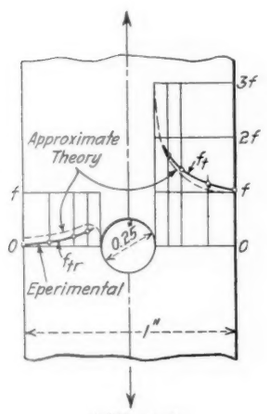
As regards the action of materials when subjected to those tests which, for convenience, we will style dynamic, or tests in which the specimen is subjected to the action of intermittent forces whose frequency of application varies more or less rapidly with time, the results are somewhat different.

*See Proceedings of the Institute of Mechanical Engineers, 1881-1885.

Materials whose properties as determined by ordinary static tests may indicate that their use is entirely justified yet fail or otherwise prove unsatisfactory in actual service.

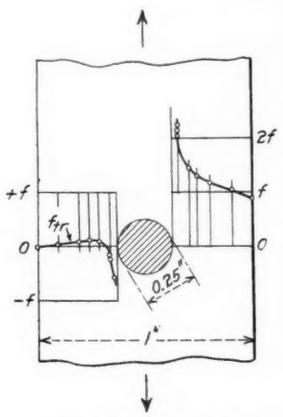
Wöhler, in his classical experiments, clearly demonstrated that loads which were sufficient to produce only a moderate amount of permanent set even when allowed to remain in action for an indefinite period of time, would eventually cause failure if applied and removed at frequent intervals. He further found that by alternately applying loads of opposite sign, such as alternating a tension load with a compression load, the period of time required for failure was shortened.

The experiments of Wöhler and others show that a steel



With Hole.

Fig. 3



Hole Fitted with Pin.

Fig. 4

bar having an ultimate strength of 60,000 lb. per sq. in., if loaded from zero to 40,000 lb. will probably break after a few thousand applications. If the upper limit is reduced 5,000 lb., so that the load varies from zero to 35,000 lb., the bar will withstand a much larger number of load applications; if this range of stress is reduced 5,000 lb. more, say from zero to 30,000 lb., it may take several million repetitions to cause failure and if loaded from zero to 25,000 lb. it will perhaps last indefinitely. If the stress varies from 25,000 lb. to 40,000 lb. per sq. in. the bar will also last indefinitely. Similar steel subjected to a stress which changes from 16,000 lb. compression to 16,000 lb. tension will fail, but if the stress changes from 14,000 lb. compression to 14,000 lb. tension the piece will probably stand an indefinite number of repetitions.

It is evident, then, that the strength of a material as determined by an ordinary static test is but one of several properties which may be essential to meet actual service requirements and it is by no means a correct indication of the ability of such materials to resist shocks or alternating loads. Thus while members having abrupt changes of general form, such as bolts and especially bolts with rolled threads, frequently fail under static loads at sections other than at the root of threads, in service failures which are brought about by gradual deterioration of the metal known as "fatigue," fracture usually occurs at those localities in which there is a sudden reduction of sectional area and under loads lighter than would be necessary to produce failure in a static test.

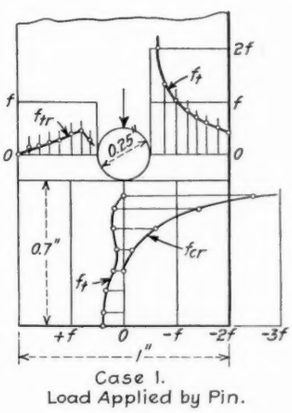
Static tests of arch bar trucks, when carried to failure, almost universally result in shearing the journal box bolts. In actual service failures it is the bottom arch bar which almost always fails, in the majority of cases at the lower radius near the column casting, although occasionally it fails at other sections and a few failures occur in the top arch bar. Many railway men with years of experience testify they have never known of a case of the journal box bolts actually shearing in service, yet if the static tests were accepted as indicative these bolts are the very parts that should be strengthened.

STRESS DISTRIBUTION IN TENSION MEMBERS

The effect upon the stress distribution across the section of a tension member, of a hole drilled through the member has been carefully investigated by several authorities. The stress diagram, Fig. 2, represents graphically the results obtained by Preuss * in the course of an investigation relative to the effect of a punched hole upon the stress distribution across the section of a flat bar. The hole, of diameter *D*, was centrally located, and the tension was exerted along the vertical axis of the bar of width *b*. The ordinates under the curved line *eg* represent the stresses at any point across the section of the bar. Preuss ascertained that the maximum stress, which occurs at the edge of the hole, is not materially affected by the magnitude of the diameter of the hole and that it is from 2.1 to 2.3 greater than the value obtained for it on the assumption of uniform stress distribution throughout the section most weakened by the punched hole. He also found that the minimum stress, which occurs at the outer edge of the bar, decreases as the diameter of the hole is increased.

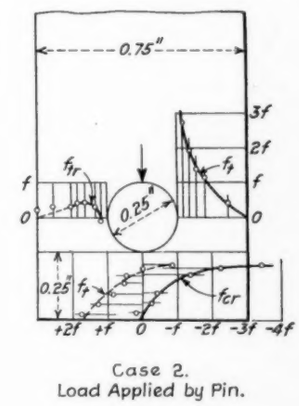
Professor Croker and Lieutenant W. A. Scoble of the Royal British Navy, have investigated (1) the stress distribution across the section of a tension member having a drilled hole, (2) the stress distribution when the hole in the tension member was fitted with a pin, and also (3) the stress distribution when the load was applied through the pin.

Figs. 3, 4, 5 and 6 are reproduced from a paper on "The Design of Pin Joints Based on Ultimate Strength"† by Lieutenant Walter A. Scoble, R. N. V. R., which appeared in *Engineering*, London, April 20, 1917. In Fig. 3 case (1) is illustrated, a plate tension member of one inch width having a 0.25-in. hole drilled at the center of its width. The intensities of the stresses across the narrow section of the test specimen, indicated by the line *oo* through the center of the hole, are plotted from *oo* as a base. The longitudinal



Case 1.
Load Applied by Pin.

Fig. 5



Case 2.
Load Applied by Pin.

Fig. 6

stress on the section *oo*, that is, the tension in the same direction as the pull, is indicated by the curve f_t at the right of the hole. The stress at right angles to the longitudinal stress, is denoted by the curve f_{tr} at the left.

Instead of the uniform distribution of stress usually assumed in such cases by the designer, the stress intensity is variable across the section and increases from the edge of the plate to the edge of the hole, where it may reach a value three times as great as the stress intensity at the edge of the

*Experiments on Distribution of Stresses in Punched Flat Bars, Zeits des Vereins Deutsches Ingenieure, Vol. 56, No. 44.

†Paper read at the Institution of Naval Architects, March 28, 1917.

plate. For the ratio of this maximum stress to the mean value of the stress across the entire section they find that their results for one central hole may be expressed as

$$\frac{\text{Maximum stress}}{\text{mean stress}} = \frac{3C}{C+1}$$

where C is the ratio of the plate width to the hole diameter.

The value of the longitudinal stress on a normal section of the plate at any distance l from the center of the hole might otherwise be stated as

$$f_{(l)} = \frac{f}{2}\left(2 + \frac{r^2}{l^2} + \frac{3r^4}{l^4}\right)$$

where f is equal to the mean value of the stress over the entire width of the plate and r is the radius of the hole. From the above it will be noted that at the edge of the hole, where r equals one, the longitudinal stress is

$$f_{(l)} = 3f,$$

or three times the mean value of the stress over the entire width of plate.

The longitudinal stress is accompanied by a stress at right angles, having a value which may be expressed as,

$$f_{(r)} = \frac{3f}{2}\left(\frac{r^2}{l^2} - \frac{r^4}{l^4}\right)$$

At the edge of the hole, where r and l are each equal to unity, the radial stress is zero.

In the course of an investigation of this phenomenon Prof. Croker and Lieutenant Scoble carried out a series of tests upon a bar one inch in width and 0.186 in. in thickness and perforated with a drilled hole whose diameter was gradually increased for each test. The load, in each case, was 100 lb. and the results obtained are presented in Table I.

TABLE I.

Test No.	Diameter of hole at center of bar, in.	Stress values in lb. per sq. in. f(1)	f	f(eh)
1	1/8	549	584	1,470
2	1/8	547	620	1,560
3	1/4	568	724	1,770
4	3/8	570	868	1,850
5	1/2	613	1,035	2,040

Note
f(1) = stress at a long distance from centre of hole.
f = mean value of stress over entire width of section.
f(eh) = stress at the edge of the hole.

In Fig. 4 a tension specimen similar to the one shown in Fig. 3 was used except that the central hole was fitted with a pin. This specimen was then subjected to pull as in the previous test. The longitudinal tension, through the section *oo* was very similar to that found in the specimen with the hole not fitted with a pin. The pull on the plate caused the plate to press on the pin and the radial stress at right angles to the longitudinal stress was changed. Near the pin the plate is now in compression changing to tension a short distance out. Compression is shown below *oo*, tension above.

In Figs. 5 and 6 the tension, instead of being caused by a pull on the test specimen as in the two previous cases, was due to a load applied to the ¼-in. pin. In Fig. 5 the pin was small compared to the breadth of the plate and a considerable amount of overlap (0.7-in.) was allowed. The longitudinal tension or axial tension, f_t above *oo*, across the narrow section *oo* varies still more than in the previous cases. The section directly below the hole was also investigated and a very intense compression, f_{cr}, was found where the pin pressed on the plate. This compression diminishes rapidly as the distance from the edge of the hole increases, disappearing at about half way from the edge of the hole to the edge of the plate. The tangential stress, f_t, below *oo*, or the stress parallel to *oo* is not very high in this case.

In Fig. 6 the diameter of the hole is greater compared to the breadth of the plate, the plate in Fig. 6 being only 0.75 in. wide as against one inch in Fig. 5. The amount of the overlap is also less, being 0.25 in. The axial tension, f_t above *oo*, across the narrow section is greater at the edge of the hole than before and becomes zero at the edge of the plate. The radial compression due to the pressure of the pin on the plate, f_{cr} below *oo*, is much more intense, decreasing to zero in this case at the lower edge of the plate. The tangential stress, f_t, below *oo*, from the edge of the pin to the lower edge of the plate is like that across a section of a beam, in that near the hole the plate is in compression, changing to tension about one-fourth of the way down from the hole.

In all the above examples, such as a tension member with hole, or plate fitted with pin the stress distribution was very unequal and the stresses of greatest intensity were localized at the region near the hole.

(To be continued)

RAILROAD ADMINISTRATION NEWS

Additions to the payroll of the railroads in 1918, largely as the result of wage increases ordered by the director general, are now estimated at approximately $642,000,000, or about 37 per cent. This, however, is the total increase in the payroll and is affected to some extent by the change in the number of employees. All of the increases, however, were not in effect for the full year and the total on a yearly basis is estimated at $810,000,000, not including the perspective large increase for the train service employees.

OVERTIME NOT CONSIDERED AS SALARY

Interpretation No. 9, relating to general order No. 27, gives a decision on the following question: If an employee covered by the provisions of general order No. 27 and subsequent wage orders issued by the director general in connection therewith, whose salary is $250 or less per month, is required to work overtime, and in a given month his total wage, including overtime, amounts to more than $250, is it the intention to restrict his earnings per month to $250?

The decision is that overtime is not to be considered as salary.

PIECE WORK BEING ABOLISHED

In accordance with instructions issued by Director General McAdoo just before he left Washington the shop employees on the various roads voted on the question of the abolition of the piece-work system. As a result of the vote piece work has been discontinued on the Pennsylvania lines, east and west, Philadelphia and Reading, Baltimore & Ohio, Delaware, Lackawanna & Western, Cumberland Valley, Long Island, New York Central, Norfolk & Western, Chicago, Burlington & Quincy, Michigan Central, Lehigh Valley, Erie, Chesapeake & Ohio, and Central of New Jersey. The Railroad Administration is following a policy of reducing the shop hours at many places where there is a surplus of labor in preference to laying off men, and the Pennsylvania shops at Harrisburg and Altoona, and shops on the Baltimore & Ohio, Hocking Valley and other roads in the Eastern region have been placed on a 40-hour week basis. While the number of employees has been reduced at various shops on many roads, there is still a shortage of men on a large number of roads, and efforts are being made to transfer men from places where there is a surplus to where there is a demand for them. It is stated that places are being made for all returning soldiers and that in some cases they are replacing inexperienced men employed during the war.

CARS TO BE RELOCATED IN ACCORDANCE WITH OWNERSHIP

W. T. Tyler, director of Division of Operation, has issued Circular No. 27, which states that present conditions with respect to car supply present an opportunity for:

(a) Relocation of equipment more in accord with ownership than has been practicable during war conditions, under which each unit has been used with the sole purpose of meeting the then existing traffic demands.

(b) Providing to a greater extent for use by the owner of equipment of its accepted standards.

(c) Providing for the return to the owning road when desired for rebuilding or application of betterments, cars which can be put in safe condition at reasonable cost.

To accomplish the above, regional directors are instructed to direct federal managers and all concerned in the proper handling of cars in accordance with the following, without abandoning the principle of common use of cars:

1. In general, cars should be loaded to or in the direction of the home road. This will not apply to cars under direction of the Refrigerator and Tank Car Department of the Car Service Section at Chicago, or those under direction of the Eastern Railroads Coal Car Pool at Pittsburgh.

2. The Car Service Section will, as may be agreed upon with regional directors, relocate equipment according to ownership by regions so far as practicable.

3. The regional directors will then relocate the same cars on the basis of ownership so far as practicable.

Form MD-35

UNITED STATES RAILROAD ADMINISTRATION
DIRECTOR GENERAL OF RAILROADS
DIVISION OF OPERATION—MECHANICAL DEPARTMENT

LOCOMOTIVE EQUIPMENT CONDITION REPORT

Week ended Saturday, ... *1919.*

..... *Railroad.*

A. Number of locomotives on line (excluding locomotives being repaired for other lines) { 1. System ..... 2. Other line ..... 3. U. S. A. ..... Total .....

B. Number of serviceable locomotives on line .....

C. Number of locomotives in shop for repairs requiring over 24 hours .....
Same date last year .....

D. Total locomotives out of service for repairs requiring over 24 hours .....
Same date last year .....

E. Number of locomotives waiting shops for repairs requiring over 24 hours .....
Same date last year .....

F. Number of locomotives due for shop within 30 days, as per company records .....
Same date last year .....

G. Number of locomotives turned out of shop receiving repairs requiring over 24 hours .....
Same date last year .....

H. Percentage of locomotives out of service for repairs .....
Same date last year .....

I. Number of locomotives necessary to send other lines for repairs (state preference as to shop) .....

J. Number of locomotives stored serviceable .....
Same date last year .....

K. Total employees of Locomotive Department { This period, 1919 ..... Same period, 1918 .....

	Machinists.	Boiler makers.	Blacksmiths.	Other mechanics.	Helpers and apprentices.	Laborers.	Other employees, Locomotive Department.
1919							
1918							

L. Number hours shops are working: First shift ..... Second shift ..... Third shift .....

M. Number hours roundhouses are working: First shift ..... Second shift ..... Third shift .....

N. Are locomotive repairs delayed by shortage of material? .....

Engine No.	Days held.	On whom ordered.	Req. No.	Date.	Kind of material.

O. Number locomotives in and awaiting shop for repairs for other lines .....

Initial.	Number.	Class repairs.	Date at shop.	Date taken in.	Date turned out.

P. Number of locomotives which can be repaired for other lines per month .....

If more space is required for items N and O, use additional sheet.

This report to be mailed to Assistant Director, Division of Operation, in charge of Mechanical Department, so as to reach his office not later than 10 days from date of report.

(*Signed*) .....

(*Title*) .....

2—6560 (*Date*) .....

New Form for Reporting Conditions of Locomotives

4. Any railroad will accept its own equipment empty at any junction point.

5. Any cars already placed on storage tracks because of surplus will not be moved so long as relocation orders placed as provided in paragraphs numbered 2 and 3 can be filled from other available supply; or as may be specially directed.

6. When roads desire to rebuild their cars, regional directors should make application through the mechanical department of the Railroad Administration, and upon its approval the Car Service Section will authorize the owners to call upon holding roads (as determined from car records) for the return of the cars in such numbers and at such times as their shop operations require. These cars are to be moved on billing stating the authority and that they must not be diverted.

7. In carrying out the policies here indicated caution should be observed by regional directors so as not to bring about burdensome empty car mileage.

The Car Service Section in Circular CS-53 has issued the following instructions: When the terms of Division of Operation Circular 20 or Revisions thereof, movement of freight equipment to the home road is requested by proper mechanical department officer such equipment shall be promptly billed and moved to owners via direct routes. The full routing, including junctions, must be shown, billing to carry the following notation: "Billed via short route. Authority Division of Operation Circular 20, revised, and Car Service Section Circular CS-53. Not to be diverted." The originating line will be held responsible for proper short routing via Federal controlled roads.

STANDARD LOCOMOTIVES DELIVERED TO FEBRUARY 22, 1919

Alabama & W. Point & Western Ry. of Ala.	2		0-8-0	American
Atlantic Coast Line	5		0-6-0	American
Baltimore & Ohio	96	Light	2-8-2	Baldwin
Belt Railway of Chicago	5	Light	2-10-2	American
Boston & Albany	10	Light	2-10-2	American
Central of New Jersey	10		0-6-0	American
	10	Heavy	2-8-2	American
Chesapeake & Ohio	15		2-6-6-2	American
Chicago & Alton	10	Light	2-8-2	American
Chicago Junction	14		0-6-0	American
Chicago & Eastern Illinois	15	Light	2-8-2	American
	5	Heavy	2-10-2	American
Chicago, Burlington & Quincy	10	Heavy	2-10-2	American
Chicago Great Western	10	Light	2-8-2	Baldwin
	2		0-6-0	American
Chicago, Indianapolis & Louisville	5	Light	2-8-2	American
Chicago, Milwaukee & St. Paul	50	Heavy	2-8-2	American
Chicago, Rock Island & Pacific	10		0-6-0	American
Cleveland, Cincinnati, Chicago & St. Louis	25	Light	2-8-2	Baldwin
Duluth, Missabe & Northern	10	Light	2-10-2	American
El Paso & Southwestern	5	Heavy	2-8-2	American
Erie	16		0-8-0	American
	15	Heavy	2-8-2	American
	1	Heavy	2-10-2	American
Grand Trunk Western	16	Light	2-8-2	American
Grand Trunk	24	Light	2-8-2	American
	4		0-6-0	American
Lake Erie & Western	15	Light	2-8-2	Baldwin
Lehigh & Hudson River	4	Light	2-8-2	Baldwin
Louisville & Nashville	20	Heavy	2-8-2	American
	17	Heavy	2-8-2	Lima
Michigan Central	20	Light	2-8-2	American
Mobile & Ohio	10		0-6-0	American
Nashville, Chattanooga & St. Louis	10	Light	2-8-2	American
New York Central	45	Light	2-8-2	Lima
	25		0-8-0	American
	50	Light	2-8-2	American
New York, Chicago & St. Louis	10	Light	2-8-2	American
Oregon Short Line	20	Light	2-8-2	American
	5		0-6-0	American
Pennsylvania Lines West	20		0-6-0	American
Pittsburgh & West Virginia	3	Light	2-8-2	Baldwin
	2		0-6-0	American
Pittsburgh, McKeesport & Youghiogheny	10	Heavy	2-8-2	American
Rutland	2		0-8-0	American
	6	Light	2-8-2	American
Seaboard Air Line	10		0-6-0	American
	10	Light	2-8-2	American
Southern	20		0-8-0	American
	25	Light	2-8-2	American
	50	Light	2-10-2	American
Terminal Railroad of St. Louis	10		0-6-0	American
Texas & Pacific	11	Light	2-8-2	American
Toledo & Ohio Central	5		0-8-0	American
	15	Light	2-8-2	American
Union Pacific	10		0-6-0	American
	20	Light	2-8-2	American
Virginian	5		2-6-6-2	American
Wabash	20	Light	2-8-2	American
Western Pacific	5	Light	2-8-2	Baldwin
Wheeling & Lake Erie	5		0-8-0	American
	10	Heavy	2-8-2	American
Total to February 22, 1919	925			

LOCOMOTIVE AND CAR DELIVERIES IN 1918

According to figures made public by Director General Hines, there were 2,622 locomotives shipped to railroads under federal control during the year ended December 31, 1918. Of this number, 744 were constructed under orders of the Railroad Administration, while 1,410 were contracted for prior to government operation. In the total were 200 Russian decapods, constructed for the Russian government, but never delivered owing to the situation which arose in that country. Of the total number of locomotives delivered during the calendar year 1918, 540 were assigned to the Allegheny region, 375 to the Central Western region, 902 to the Eastern region, 236 to the Northwestern region, 105 to the

Pocahontas region, 361 to the Southern region, and 103 to the Southwestern region.

For the calendar year 1918 there were 700 passenger cars delivered to Class I railroads, while for the same period 40,850 freight cars were delivered. Of the freight cars built during the year 15,230 were U. S. R. A. standard cars. Of the total number of freight cars delivered, 8,683 were built in railroad shops.

LOCOMOTIVE EQUIPMENT CONDITION REPORT

A new form for reporting (weekly) the condition of locomotives has been issued as shown on page 127, to be used commencing with the report for Saturday, March 1.

ORDERS OF THE REGIONAL DIRECTORS

Shop Supervision.—The Eastern regional director quotes from a letter received from W. T. Tyler, director, Division of Operation, dated January 27, as follows:

It is stated that in some of the shops where a change has been made from piecework to hourly or daily basis, the piecework checkers, usually clerks or office men, have been put in the position of foremen at foremen mechanics' rates. I suggest the advisability of cautioning federal managers against leaving any opportunity for criticism in connection with this matter.

Inspection at Interchange Points Covering Loading.—Circular No. 422 issued by the southern regional director says that there has been some duplication of inspection at interchange points covering loading, bracing, stability of packages and general condition of freight offered in interchange. Such inspection and records must be made only by the receiving railroad.

Associations Approved.—The Southern regional director, file 841-6, advises that the director general has approved the Chief Interchange Car Inspectors' and Car Foremen's Association. Similar orders have been issued by the Southwestern and Northwestern regional directors.

General Foremen's Association.—The Northwestern regional director, file 61-1-20, advises that employees who are members of this association be allowed to attend the annual convention, which will be held in the fall of 1919, where they can do so without detriment to the service; transportation should be furnished and necessary expenses allowed.

THE VALUE OF INSULATION AND LOSSES IN B. T. U.'S

BY WILLIAM N. ALLMAN

The question of fuel conservation is one that is now being urged very forcibly upon power plant engineers and operators, and it is quite surprising to note what a large portion of the energy may be saved and converted into useful work by the proper use of insulation.

By the term insulation is meant the proper protection of heated surfaces to prevent the loss of heat, which is measured in terms of British thermal units, and which losses are often underestimated. We have often noted that great care is exercised in guarding against losses in electrical distribution and water leakage and against undue loss in steam pressure between the source of power and the prime movers, yet little or no attention is given to the proper insulation to guard against B. t. u. losses, which are now acknowledged as a vital factor in power plant operation, and so much so that engineers everywhere are now very much engaged in studying these conditions and locating those places where losses may be reduced with a consequent saving in the coal pile.

Steam piping running from boilers to engines and auxiliaries, and hot water lines from heaters and feed pumps, make up a big area of heat radiating surface and so offer opportunities to effect immense savings.

It has been estimated that the loss of heat from bare or poorly insulated pipes represents a loss in fuel ranging from 25 to 75 per cent, and for the reason that this is invisible it can hardly be realized. On the other hand, if it were in the form of a liquid and were visible, steps would be quickly taken to prevent such a loss. Although the eye cannot detect the escape of heat, scientific tests show that a tremendous waste occurs through radiation and poorly insulated pipes.

A large percentage of heat that would be lost if pipes and other apparatus were left bare can be saved by applying the right kind of insulation and thereby preventing unnecessary loss of heat by radiation. It is of importance to select insulation adapted to the service involved to obtain the maximum efficiency, and it is therefore necessary that the proper thickness of insulation be installed. The loss by radiation varies with the difference between the temperature of the steam and the surrounding air and upon the conductivity of the pipe and its covering and upon the extent of the exposed area. An insulation that would allow no heat to escape through it would, of course, be rated as 100 per cent efficient, but this condition does not exist. The efficiency of an insulating material is expressed in terms of percentage, which is the per cent saving realized by insulating a heated surface over what would be lost if the conductor were left bare or uninsulated.

The rate of flow of heat through a certain thickness of material and at a certain difference in temperature determines the conductivity of the material. The relative efficiencies of insulating materials are obtained by comparing their conductivities under similar conditions.

Heat is also frequently wasted where sections of insulation are not closely joined, either on a length of piping, or at its connections with fittings or specialties. All joints or seams in pipe insulation should be carefully sealed. This is especially true where use is made of insulation of a cellular type, allowing circulation of air through longitudinal cells parallel to the pipe.

Different methods of conveying heat and power from one building to another have been developed with widely different resulting efficiencies and costs. One method of distribution has been to surround underground pipes with some form of insulation that rapidly depreciates after installation. Another construction is the tunnel method, with pipes properly insulated, which is efficient but extremely expensive. Again, pipes are very often run overhead out of doors, the insulation being protected by some form of weatherproof jacket. This method is inconvenient as well as not presenting a very neat appearance, and unless very thick insulation of high insulating value is used the results are not what they should be. The underground system with the lines out of sight as well as out of the way and where they cannot interfere with traffic and plant operation should be the most acceptable, provided that the cost compares favorably with other systems and that its insulating value will not depreciate very rapidly.

Table I shows the amount of heat, in B. t. u.'s, lost where pipes are uncovered. It will be seen that a considerable loss of fuel will be occasioned in the course of a year with uncovered pipes, which could be considerably reduced by proper insulation.

There are numerous places in the power plant where savings may be effected by proper and judicious use of insulating materials and elimination of leaks. Items that should receive special attention are leaky baffle walls in boiler settings, infiltration of air through the furnace walls, bare steam pipes, boilers, cylinders, etc. Unless baffle walls are made tight there will be a loss of heat, as the heat which should be passing over the heating surface of the boiler will be short-circuited to the chimney. Cracks in boiler walls may not be very apparent, yet the admission of air through them is more than enough to lower the efficiency of the boiler. This air leakage may easily be detected with a sheet of paper,

say, two feet square, having a small hole in the center of it about one inch in diameter, glued to a square wooden frame made of about one-inch stock. Place the frame over the wall and seal the edges all around, then hold a candle or torch in front of the hole. If there are leaks in the setting the flame will be drawn towards the hole in the paper. This matter of air leakage is extremely important, and yet very easy to correct. The application of proper insulation not only prevents the infiltration of air, but reduces the loss of heat from the boiler walls as well. It should be borne in mind that cold air that leaks in through the walls absorbs heat until it reaches the temperature of the furnace gases, and hence wastes heat that would otherwise perform useful work.

More horsepower from the coal pile is the one big problem that confronts all power plant engineers. As an illustration of what and where losses may occur in the average power plant, Table II, extracted from Joseph W. Hays' treatise on "How to Build up Furnace Efficiency," is shown. A large amount of heat is shown under the head of preventable losses which may be converted into useful work.

Table I—Total Heat Loss in B.t.u.'s Per Hour Per Lineal Foot of Bare Pipe of Different Sizes and at Various Temperatures

Size of pipe in in.	Area (in sq. ft.) of pipe surface per lin. ft.	Temperature Differences (Degrees "F") 50	100	150	200	250	300	350	400	450	500
¼	.220	21.5	47.3	79.2	117.3	162.3	215.2	279.1	355.1	451.4	569.8
¾	.274	26.8	59.0	98.6	146.8	202.1	268.5	347.6	442.2	562.2	709.7
1	.344	33.6	74.0	123.8	183.4	253.7	337.4	436.5	555.2	705.4	891.0
1¼	.435	42.5	93.6	156.6	231.9	320.8	425.4	551.9	702.1	892.6	1,126.7
1½	.498	48.7	107.2	179.3	265.4	367.3	487.0	631.8	803.8	1,021.9	1,289.8
2	.622	60.9	133.9	223.9	331.5	458.7	608.3	789.2	1,003.9	1,276.3	1,611.0
2½	.751	73.4	161.6	270.4	400.3	553.9	734.5	952.8	1,212.1	1,541.1	1,945.1
3	.917	89.6	197.3	330.1	488.8	676.3	896.8	1,163.4	1,480.0	1,881.7	2,375.0
3½	1.047	102.3	225.3	376.9	558.1	772.2	1,024.0	1,328.4	1,689.9	2,148.4	2,711.7
4	1.178	115.1	253.5	424.2	627.9	868.8	1,152.1	1,494.6	1,901.3	2,417.3	3,051.0
4½	1.308	127.9	281.5	470.9	697.2	964.7	1,279.2	1,659.5	2,111.1	2,684.0	3,387.7
5	1.455	142.2	313.1	523.8	775.5	1,073.0	1,423.0	1,846.0	2,348.4	2,985.7	3,768.5
6	1.733	169.4	371.9	623.9	923.7	1,278.1	1,694.9	2,198.7	2,797.1	3,556.2	4,488.5
8	2.257	220.6	485.7	812.5	1,203.0	1,664.5	2,267.3	2,863.6	3,642.8	4,631.4	5,845.6
10	2.817	275.4	606.2	1,014.1	1,501.5	2,077.5	2,755.0	3,574.1	4,546.6	5,780.5	7,296.0

Table II—Fuel Wastes Between the Mine and the Machine

	Direct Fuel Wastes	Pre-ventable losses, B.t.u.	Non-Pre-ventable losses, B.t.u.
1.	By weather waste between mine and factory	.....	290,000
2.	In handling at the plant	290,000	.....
3.	In the ash (non-preventable)	.....	284,200
4.	In the ash (preventable)	1,136,800	.....
5.	By radiation (non-preventable)	.....	284,200
6.	By radiation (preventable)	852,600	.....
7.	By incomplete combustion	204,908	.....
8.	In chimney to maintain draft	.....	3,410,400
9.	On account of air leakage in furnace and boiler setting	2,842,000	.....
10.	On account of excess air drawn through grates	2,842,000	.....
11.	Due to heating moisture in air and coal	.....	426,300
	Totals	8,168,308	4,695,100
	INDIRECT FUEL WASTES—HEAT ENERGY LOSSES		
12.	Due to short circuiting of gases in passages of boiler	322,732	.....
13.	Due to soot on heating surfaces	1,126,561	.....
14.	Due to scale in boiler	1,452,293	.....
15.	Due to incorrect correlation of load to draft	1,116,800	.....
16.	Due to inability of boiler to reduce temperature of gases below that of the steam in boiler	.....	1,280,907
17.	Due to leakage of water and steam	216,685	.....
18.	Due to friction and radiation in steam pipes (non-preventable)	.....	216,685
19.	Due to friction and radiation in steam pipes (preventable)	866,742	.....
20.	With engine exhaust	.....	7,627,331
21.	Due to cylinder condensation and radiation	715,063	.....
22.	In friction at engine (non-preventable)	.....	119,177
23.	In friction at engine (preventable)	59,588	.....
24.	In transmission from engine to machine (non-preventable)	.....	231,000
25.	In transmission from engine to machine (preventable)	231,000	.....
	Totals	6,107,464	9,475,100
	Grand totals	14,275,772	14,170,200
	Totals of all losses preventable and non-preventable	28,445,972 B.t.u.	
	Delivered to the machine	554,028 B.t.u.	
	Received from mine	29,000,000 B.t.u.	

Note—One ton of coal at the mine is assumed to contain 29,000,000 B.t.u.'s. The items show where the losses occur and their relative magnitude in the average boiler and engine practice.

Now let us ask the question: In the face of all the facts and the serious questions that now affront us, why is fuel wasted, especially when it is one of the most vital factors of the present day in power plant operation? Why is it that the operators are not more persistent in their efforts to locate where the losses occur and then seek a means of reducing them and of putting their plant on a high efficiency basis? We all have heard and no doubt are familiar with the term "passing the buck," and the writer is of the opinion that if this were eliminated from the fireman up to the manager and if everyone would bear in mind that fuel is now the most costly thing they have to deal with, then and then only will the maximum efficiency be realized.

The selection of the proper insulating material with due reference to its insulating efficiency and durability should follow a careful analysis of the conditions and requirements of the case in question. The greatest savings, of course, are to be had by properly insulating the high pressure and high temperature steam lines. Inspect the equipment and ascertain all of the uninsulated surfaces such as steam chests, cylinder heads and all other hot surfaces, which in the aggregate result in high heat losses.

Table III shows what losses may be expected in uninsulated surfaces.

Table III—Heat Losses from Uninsulated Hot Surfaces

Temperature of Surrounding Air 70 Deg. F.

Steam pressure (gage)	Steam temperature (deg. F.)	Difference between temperature of steam and surrounding air (deg. F.)	Loss per sq. ft. per hour (B.t.u.)	Waste of coal in lb. per sq. ft. per year	Number of sq. ft. of surface that wastes a ton of coal in one year
0	212	142	334.0	293	6.82
10	240	170	425.0	372	5.38
25	267	197	522.5	458	4.37
50	298	228	644.0	564	3.55
75	320	250	737.5	646	3.10
100	338	268	820.0	718	2.79
150	366	296	960.0	840	2.38
200	388	318	1,079.0	945	2.12
250	406	336	1,184.0	1,036	1.93

Above figures based on 10,000 B.t.u.'s available per pound of coal, or equivalent to a boiler efficiency of 70 per cent, using coal with an assumed heat value of about 14,000 B.t.u.'s per pound.

The figures are conservative, as both the boiler efficiency and the heat value of the coal are high and a lesser boiler efficiency or inferior grade of coal would cause even a greater waste in pounds of coal.

The loss of steam through open petcocks of steam traps or through leaky traps is extremely large. Leakage is generally due to parts of the trap binding or sticking, worn valve or seats, improper adjustments, defective or worn-out expanding members, etc. It is important that traps and their parts should be frequently and carefully inspected. Steam traps with large surfaces are very often left uninsulated, which results in a considerable loss due to radiation. This loss may be prevented by the application of suitable insulation.

Fuel Conservation Circular No. 14, recently issued by the United States Railroad Administration, is right to the point and the 34 suggestions under the heads of Plant Design and

Equipment, Maintenance and Operation, should be read very carefully by all concerned in the operation of power plants.

The United States Fuel Administration is making every effort to bring home to fuel users the gravity of the situation and the importance of coal and power economy. Only by the whole-hearted co-operation of all power plants, large and small, can the desired savings be effected.

In general, encourage those who work in boiler plants, engine rooms, factories, etc., to be continually on the lookout for heat and fuel losses. Such losses are not difficult to detect. Steam waste can readily be seen and heat felt. If those who discovered steam leaks or loss of heat would take the time and trouble to see whether or not it can be conserved, and then look for the remedy, not only would the nation's fuel be conserved, but the efficiencies of plants and the profits of owners would be increased.

A UNIFIED MECHANICAL DEPARTMENT*

Suggestions for Co-ordinating the Efforts of Shop, Operating and Mechanical Engineering Branches

BY W. U. APPLETON

Superintendent Motive Power, Canadian Government Railways, Moncton, N. B.

A SYSTEM for regulating and combining the various branches of the mechanical department into one organization that will produce satisfactory service in the general repair shop and the operating branch, obviously, must be broad and definite in its principles. Harmony between the various officers is essential and the relationship between the branches must be very intimate. Success cannot be obtained if the general repair shop and the operating departments are not closely allied; if the shop superintendent is working with the one object of output and the operating officers are not making every effort to obtain the greatest mileage from the locomotives consistent with good service and economy, failure is sure to result.

In order to get results, it is necessary that we should have that co-operation whereby the shop superintendent and all his subordinate officers are giving the same attention to proper repairs as to output, and it should be the object and pride of every master mechanic and his subordinate officers to obtain the greatest mileage between shoppings with the least number of failures.

To repair a locomotive quickly, cheaply and properly, should be the ambition of the shop superintendent.

To maintain it in service with a minimum expense and the greatest number of miles between failures and shoppings, should be the aim and object of the master mechanic.

When locomotives are sent to the shop there should be some system of defining the class of repairs required, and the writer believes that three classes as described below is the best method and sufficient to take care of all repairs:

No. 1—General repairs, including a new firebox, a new cylinder or other such extra heavy repairs.

No. 2—Ordinary general repairs.

No. 3—Specific repairs that may be carried out at the roundhouse or shop.

Abbreviations as follows should be used in conjunction with the numbers to describe specific repairs:

No. 1 Repair	Convers.	means conversion to superheater, etc.
	Boil.	means new boiler.
	F. B.	means firebox.
	Cyl.	means cylinder one or two.
	Fra.	means frames.
	Int.	means internal examination.
	Ext.	means external.
	Der.	means derailment.
No. 2 Repair	Int.	means internal examination.
	Ext.	means external.
	Der.	means derailment.
	T.	means new tires.
No. 3 Repair	T. T.	means tires turned.
	Fr. W.	means frame welded.
	An. T.	means annual test.
	Int.	means internal examination.
	TU.	means fixing up tubes.
	DB.	means driving boxes.
	Der.	means derailment.

No. 1 or No. 2 repairs should not indicate any difference in the condition of the locomotives when turned out of the shop as far as the Operating Department is concerned, as the distinction is only made for the information and assistance of the shop force in effecting repairs, and either of these repairs should represent a locomotive in first class condition in every respect, and capable of making the standard mileage of its class, according to the physical characteristics of the division on which it is employed and the service it is in.

The condition of all parts of the locomotive should be as nearly balanced as possible in order to obtain the greatest mileage with the least loss of service. It is false economy to turn locomotives out of the shop represented as having received the above classes of repair, with certain parts somewhat worn, because they have been renewed a short time previous to shopping. For instance, it may seem wasteful to renew tubes or some part of the machinery that is apparently still capable of making considerable mileage, but as these parts will become defective and make renewal necessary before those that were brought up to standard of shop practice, the result usually is an engine out of service when badly required, delay in effecting repairs and higher cost of doing so on account of lack of facilities at engine-houses as compared with shops.

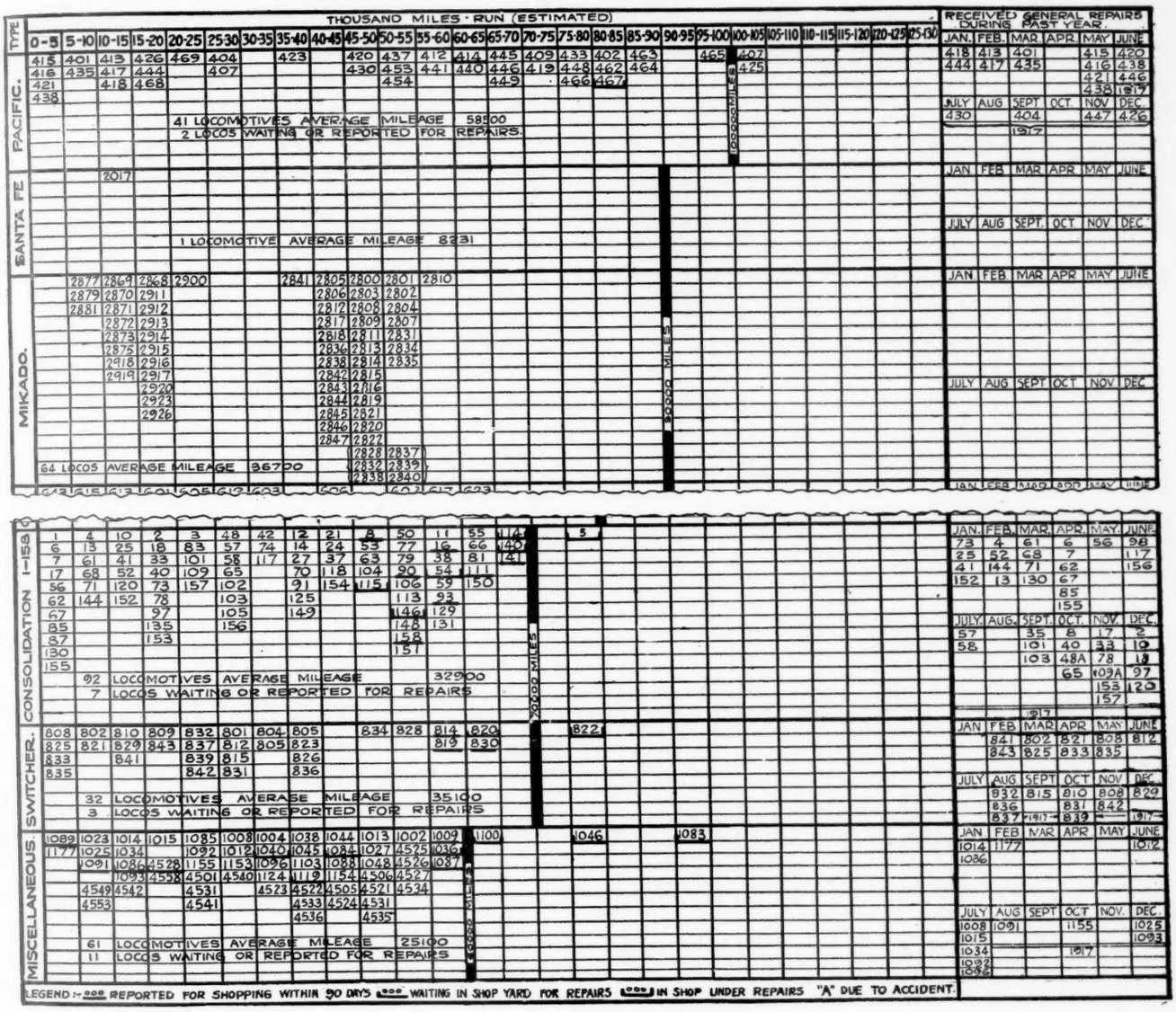
No. 3 repairs differ entirely from those referred to. This class represents specific work and may be done at engine-houses or shops. It is sometimes the result of an accident to or failure of some particular parts, but is generally due to ordinary wear and tear of certain parts of the locomotive that are subject to the most severe service. The parts subject to the greatest wear would not, if the locomotive is properly maintained while in service, represent sufficient work to justify a No. 1 or No. 2 repair, and in order to enable these parts to continue their work until the locomotive is generally worn to the extent necessary to justify a shop repair, it is usually economical to effect such repairs.

The latter class of repairs generally consists of partial renewal of tubes and flues, rod bearing work, lining up wedges, examination of pistons and valves, refitting main driving boxes, removal of lateral play from wheels, and sometimes tire turning. The parts requiring attention will, of course, be found to vary considerably with the different classes of locomotives as well as with the different classes of service they give and the subdivisions on which they are employed. In some classes of locomotives on some subdivisions the tubes and flues will run from shopping to shopping with very little trouble, while others on the same division or the same class on another division will require partial renewal when little more than half the required mileage has been accomplished.

The constant introduction of larger power is so changing conditions as to make the question of doing No. 3 repairs at

* From a paper read before the Canadian Railway Club.

engine-houses one of considerable controversy and the question naturally arises as to the best method of taking care of this work. In the writer's opinion the No. 3 repair should take care of this work except on the smaller and medium classes of power. At engine-houses where there is a heavy fluctuation in traffic it is an advantage to have a No. 3


THOUSAND MILES · RUN (ESTIMATED)
RECEIVED GENERAL REPAIRS DURING PAST YEAR
PACIFIC.
41 LOCOMOTIVES AVERAGE MILEAGE 58500
2 LOCOS WAITING OR REPORTED FOR REPAIRS.
SANTA FE
1 LOCOMOTIVE AVERAGE MILEAGE 8231
MIKADO.
64 LOCOS AVERAGE MILEAGE 36700
CONSOLIDATION 1-15
92 LOCOMOTIVES AVERAGE MILEAGE 32900
7 LOCOS WAITING OR REPORTED FOR REPAIRS
SWITCHER.
32 LOCOMOTIVES AVERAGE MILEAGE 35100
3 LOCOS WAITING OR REPORTED FOR REPAIRS
MISCELLANEOUS.
61 LOCOMOTIVES AVERAGE MILEAGE 25100
11 LOCOS WAITING OR REPORTED FOR REPAIRS
LEGEND:- REPORTED FOR SHOPPING WITHIN 90 DAYS WAITING IN SHOP YARD FOR REPAIRS IN SHOP UNDER REPAIRS "A" DUE TO ACCIDENT.

No. of Locos. Tributary to Moncton Shops.
In roundhouse service 338
In repair shops and yards..... 31
Total 369
Loco. Mileage for April, 1918.
Average Per Loco. in Service, 2392.
11 Locomotives Should Receive General Repairs Proportionate to Above Mileage Excluding Accidents.
11 Locomotives Received General Repairs and 2 Locomotives Received Special Light Repairs During May, 1918.
5 Locomotives Sent in for General Repairs Before Making Standard Mileage:

Loco. No.	Mileage	District
54	55725	4
115	43454	6
146	51821	2
467	80337	3
1040	27992	3

LOCOMOTIVES REPAIRING AND IN SHOP YARDS

Waiting repairs Loco. No.	Date of arrival.	Repairing in shop Loco. No.	Expected out.	
1917				
1083	8-28	5	6-13	1918
1089	11-2	54	8-2	"
1087	8-10	67	6-19	"
1046	9-15	77	6-3	"
1918				
414	5-10	114	6-16	"
615	4-10	115	6-25	"
1036	4-17	140	7-3	"
1084	4-10	146	Waiting	For Cyl.
1086	5-10	284	6-17	1918
1091	1-9	287	6-18	"
1119	4-10	288	6-18	"
4528	4-24	303	6-3	"
M & B No. 3	4-29	308	6-5	"
		407	6-18	"

Total No. of Locomotives Waiting or Reported for Repairs:
Serviceable, 27.
Unserviceable Subject to Instructions, 7.
8 per cent of Serviceable Locomotives Under Repairs and in Shop Yard Waiting.
Locomotives Superheated During Month: No. 438.

Fig. 1—Canadian Government Railways Form Showing Conditions of Locomotives

be continued and not confused with the heavier repairs under classes 1 and 2, this being important in order to determine the condition of the power at all times based on mileage made according to class of repairs, and to avoid expenditures on the power that should not be necessary.

Facilities at engine-houses are generally inadequate to repair gang, as it enables those in charge to hold their staff together and they can be employed to advantage on running repairs when necessary.

In general repair shops where the work is done on schedule and arranged so that the engines will be turned out at regular intervals and No. 3 repairs cannot be taken care of

without interfering with the regular work, it is a debatable question as to the advisability of breaking up the organization in order to take care of this work, although under existing conditions there is usually no alternative. The changing conditions will, no doubt, make it necessary to provide certain space in general repair shops for this class of work, where it may be done at lower cost than at engine-houses. Where locomotives have to be hauled or worked a long distance to get to the general repair shop for such repairs, it might be advisable to provide a small shop for this class of repair if the number of engines tributary to it is sufficient.

To enable the shop superintendent to plan his work and maintain his schedule, it is only fair that he should be given all the advice possible as to the class of repair, and a list of the important parts that require replacement at least 30 days in advance of the locomotive coming to the shop. While it may not always be possible to do this on account of engines being damaged in accidents, there is no reason why it cannot be done to a very large extent in ordinary service. A form for reporting the work, shown in Fig. 2, has been found to be very satisfactory.

When making out this report of shop repairs required, master mechanics should devote particular attention to the note advising them to describe any unusual defect.

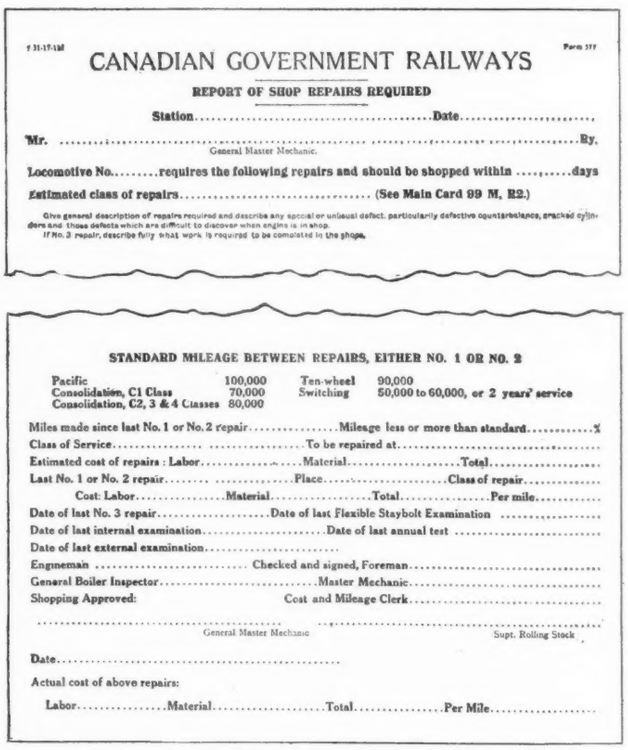
We all know that when a group of engines is built from the same drawings, even though all the parts are duplicate in every respect, no two of these engines will behave alike in service, but that each individual machine will have its own peculiar virtues and vices. For instance, one engine may jig and ride badly, perhaps the fault is more apparent at certain speeds than at others, and again it may vary with the position of the reverse lever and according to whether the engine is working hard or light. There are several things which might cause this trouble, and unless full particulars are given the real cause may be overlooked, but if the master mechanic will take particular care to describe the defect with all the symptoms he will give the shop superintendent a chance to determine the seat of the trouble.

On taking over an engine from the shop after repairs, the operating department should keep a very sharp lookout for any defect which may be actually present or beginning to develop, and these defects should be completely reported to the shop superintendent within 30 days of the date the engine goes into service. What too often happens is that the operating department will run the engine until there is a failure and then endeavor to throw the whole blame for the failure on the shops, whereas they are really as much to blame as the shops for not reporting the defect earlier.

There are some kinds of defects which often manifest themselves on an engine from the shops, which will disappear after a few days or a few weeks in service, and the operating department often makes the mistake of neglecting to report these defects, as they feel confident that the engine will come round to her work after a week or two in service. Very often their judgment proves correct, but the best policy in cases of this kind is to report the defect immediately, keep a strict watch on it and if no improvement is noticeable within a very short time the defect must be rectified to avoid any chance of engine failure.

The standard maintenance regulations in force on most roads, if faithfully carried out, will prevent a very large percentage of ordinary running failures, but there is a class of failures which cannot be guarded against by any such regulations. I mean failures due to faulty design and poor material. To deal with the failures of this kind is, obviously, the business of the (mechanical) engineering department, and their first and greatest effort should be to locate the prime cause of the failure. Very often the actual part which fails is not the part which is at fault, and if we go ahead blindly and strengthen this part, the evil will not only break out in another place, but very likely with worse results. The maxim of the engineering department should be first to find the root of the trouble and then rectify it.

To determine the mileage that should be obtained from the different classes of locomotives, considerable study and investigation is required, and, in the writer's opinion, a minimum mileage requirement should be established for all sub-divisions for the various classes of locomotives according to service, after receiving a No. 1 or No. 2 repair. If this is not done there is every possibility of locomotives being shopped for expensive repairs before actually required, while others, overdue for shopping on a basis of work done, remain in service, a source of trouble and expense to everybody. We make tests and establish standards as to tonnage that locomotives of the same class shall haul and they are not arbitrary for all divisions irrespective of grades and curves; then why require a locomotive to make as much



CANADIAN GOVERNMENT RAILWAYS

REPORT OF SHOP REPAIRS REQUIRED

Station.....Date.....

Mr. .....Ry.
General Master Mechanic.

Locomotive No.....requires the following repairs and should be shopped within .....days

Estimated class of repairs..... (See Main Card 99 M. R2.)

Give general description of repairs required and describe any special or unusual defect, particularly defective counterbalance, cracked cylinders and those defects which are difficult to discover when engine is in shop.
If No. 3 repair, describe fully what work is required to be completed in the shops.

STANDARD MILEAGE BETWEEN REPAIRS, EITHER NO. 1 OR NO. 2

Pacific	100,000	Ten-wheel	90,000
Consolidation, C1 Class	70,000	Switching	50,000 to 60,000, or 2 years' service
Consolidation, C2, 3 & 4 Classes	80,000		

Miles made since last No. 1 or No. 2 repair.....Mileage less or more than standard.....%
Class of Service.....To be repaired at.....
Estimated cost of repairs: Labor.....Material.....Total.....
Last No. 1 or No. 2 repair.....Place.....Class of repair.....
Cost: Labor.....Material.....Total.....Per mile.....
Date of last No. 3 repair.....Date of last Flexible Staybolt Examination.....
Date of last internal examination.....Date of last annual test.....
Date of last external examination.....
Enginemain.....Checked and signed, Foreman.....
General Boiler Inspector.....Master Mechanic.....
Shopping Approved: Cost and Mileage Clerk.....
.....
General Master Mechanic Supt. Rolling Stock
Date.....
Actual cost of above repairs:
Labor.....Material.....Total.....Per Mile.....

Fig 2—Form for Reporting to Shops Advance Information Concerning Repairs Required by Each Locomotive Shopped

mileage with the same repairs in way-freight service on a heavy division as in through service on a light division?

Locomotives in assigned service will, I am satisfied, make more mileage at less cost than those in the pool, and in a given time—say 18 months—the assigned engine will possibly make the greater mileage, due to its receiving more care and attention which will keep it in continuous service; but in a rush of traffic for a short period the pooled engine will make the greater mileage. Where traffic is fairly steady I believe that the assigned system is the best, but where heavy fluctuations in traffic have to be met, it might entail too great a capital outlay. I have known a locomotive in assigned service, when the engineer was taking an interest in his work, to make 55 per cent more mileage than a locomotive of the same class in the same service and on the same division, in the pool.

The movement of power from one division to another should be done only under the advice of the motive power department, because otherwise it would possibly result in some roundhouses having a high percentage of power over

the shopping period and others with a similar proportion of power just out of the shop.

In order that we may have a comprehensive idea of the condition of our power at all times, the monthly statement illustrated in Fig. 1 has proved to be of considerable value. The form is self-explanatory and it is easy to get an idea of the condition of any particular locomotive, of the general condition of a particular class of locomotive, of the number of locomotives due for shopping, etc.

It will be noticed that in the mileage established for different classes of locomotives there is no provision made for the class of service in which the locomotive is engaged, and it is therefore necessary sometimes to reduce the mileage required for locomotives working under severe conditions, such as way-freight service on a heavy division. It is a difficult and unsatisfactory matter to make rigid laws in such cases and the rules are necessarily slightly elastic.

To sum up, co-operation between the various branches of the mechanical department depends very much more on the men than on the system, and if the heads of the different departments all pull together with the idea of attaining greater efficiency and their subordinates back them up, it will not be difficult to get results.

The operating department should be very careful and very complete with their reports of repairs required when sending locomotives to the shop and should promptly report any defects in engines turned out of the shop.

The shops department should work conscientiously with the idea of making all locomotives good for their full mileage, and should pay special attention to any peculiar or unusual defects reported by the operating department.

The (mechanical) engineering department should be ready at all times with advice and assistance to the shops and operating departments, and when investigating any defects should spare no pains to get right at the root of the trouble before attempting to eliminate it.

STEAM VS. ELECTRIC LOCOMOTIVES*

Intelligent Comparison of the Two Types Requires a Knowledge of the Characteristics of Each

THE tractive effort of the simple locomotive can be easily calculated from the following formula:

$$TE = \frac{0.85 \times P \times C^2 \times S}{D}$$

where TE = rated tractive effort at rim of driving wheel in pounds.
P = boiler pressure in pounds per sq. inch.
C = diameter of cylinder in inches.
S = stroke in inches.
D = driving wheel diameter in inches.

The maximum tractive effect in general corresponds to about 22 per cent adhesion between the drivers and the rail. Loads on the locomotive must be of such a maximum value that there is a small percentage of tractive effort available for possible starting under maximum grade and load conditions. The locomotive must be rated in terms of maximum load in tons for the division over which it operates, and this maximum tonnage must be corrected for temperature during the winter months. This rating is mentioned because it corresponds somewhat to the continuous rating of the electric locomotive, which we will take up and discuss further on in this article.

The torque of the motor is the pull which it can exert at one foot radius from the center of the armature shaft, i. e., at any point in a circumference of a circle 24 in. in diameter. The formula for the electric locomotive is:

$$TE = \frac{T \times 24 \times G \times \text{gear efficiency} \times N}{D \times g}$$

Where TE = tractive effort
T = torque of motor
G = number of teeth in gear
g = number of teeth in pinion
D = diameter of driver in inches
N = number of motors

The above formula is a general one and considers gearing as the mechanical connection between the motors and the drivers. So as to provide a ready means of enabling the railroad man to calculate the tractive effort and to know the performance of the electric locomotive under consideration, a set of curves are drawn, known as the characteristic curves. These curves show the relation between the current taken by the motor, the torque development and the revolutions. This data is then used to make up a set of curves for the complete locomotive, so that it is possible to read off the total current taken by the locomotive, the pounds tractive effort and the corresponding speed. The tractive effort is obtained by the formula given, and the miles per hour equals

$$\text{r. p. m.} \times D \times \frac{g}{G} \div 336$$

It is apparent that the tractive effort depends on the amount of current which passes through the motors, this current value being at the control of the engineer. There is a practically unlimited supply of power available at the power house compared to that developed by one steam locomotive, and the maximum power the electric locomotive is capable of developing does not depend on a fixed condition as in the case of the boiler of the steam locomotive. It is possible, therefore, to take advantage of extra adhesion with the electric locomotive. This extra adhesion may be natural or caused by the application of sand, and a value as high as 35 per cent has been obtained.

It is not possible to maintain this high maximum tractive effort continuously, which the steam locomotive is capable of doing, on account of resultant damage to the motors, but there is a tractive effort which can be maintained continuously by the locomotive. This leads up to what is meant by the continuous and hourly rating of an electric locomotive.

The tonnage rating of the steam locomotive corresponds, as nearly as the two entirely different machines can be compared, to the continuous rating of the electric locomotive. The continuous rating is fixed, but in a different way from the tonnage rating. The tonnage rating means that this is the maximum load it is safe to haul if the train is to be gotten over the road—allowance being made for a reduction in tractive effort due to poor coal and other factors.

With the electric locomotive, it does not mean that if the continuous rating is exceeded the locomotive will not be able to take the train over the road. It will pull the train and do it on schedule, but it may be at the expense of overheating the motors, and the question of whether damage will result depends on the time the overload is maintained. In addition to the continuous rating, there is the hourly rating which is higher than the continuous rating. Starting with the engine cold, the hourly rating represents the tractive effort which the locomotive could exert for one hour without overheating the motors. The hourly rating is a rating which

*Abstract of an article by A. J. Manson, Westinghouse Electric & Mfg. Co., appearing in the February number of the Railway Electrical Engineer.

does not exist in the steam locomotive. In the latter, the tractive effort depends entirely on the mean effective pressure in the cylinders, while in the former it depends on the amount of current passing through the motors. The current flowing through the motors causes the fields and armatures to heat, on account of the resistance of the conductors. This heat is conducted away by the iron and by radiation, and the whole motor becomes heated. A certain constant current flowing through the motor continuously, will result in a certain temperature rise above the surrounding air, the extent of this depending on the value of the current.

While the electric insulation used in the motor will not be injured if an occasional temperature of 100 deg. C. is reached in service, the ratings of the motors are for a much lower temperature rise—namely, from 60 to 70 deg. C. by thermometer. A continuous current which will give 60 deg. C. rise in temperature is the continuous current rating, and the tractive effort corresponding to this continuous current rating is the continuous tractive effort rating of the locomotive. The hourly rating would be the higher current (and the tractive effort corresponding), which in one hour would give the 60 deg. C. rise. Likewise there can be an indefinite number of ratings for any particular time from say 5 to 10 minutes up to the continuous time. It is the practice, however, to give only the continuous and hourly rating. A very much larger current can be taken for a shorter time without exceeding the allowable temperature rise, and so it is possible to rate the locomotive at a much larger tractive effort for a short time performance.

The tonnage rating of the steam locomotive is the rating for a particular division (varying with different service conditions) and is governed by the maximum grade, or by the pull which will be required of the locomotive. The load will be governed by this maximum condition. In the case of the electric locomotive, high tractive efforts can be exerted for short periods of time so that the loading does not depend upon the maximum grade encountered, but upon the whole profile. The load will be governed by what the temperature of the motors will be at the end of the run—not by what the maximum pull may be for 5 or 10 minutes. Therefore, it becomes possible to give the electric locomotive a higher tonnage rating for the same weight upon the drivers than would be possible with the steam locomotive.

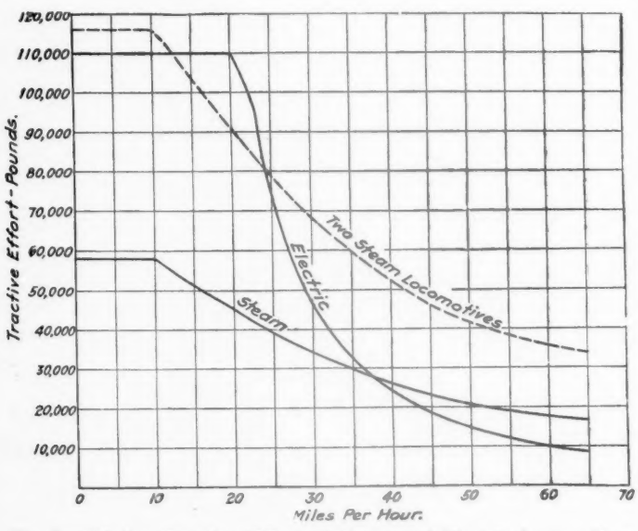


Fig. 1—Relative Tractive Effort of Steam and Electric Locomotives of the Same Weight Operating at Various Speeds

There is one more very important point which should be thoroughly understood and appreciated, when considering the electric locomotive, and that is the "horsepower" rating. Horsepower is the product of the tractive effort and the speed. It is a direct measure of the locomotive's capacity to do work. Tractive effort tells how much trailing load can be handled, but it is the horsepower that measures the hourly ton-miles. Electric locomotives excel steam locomotives in this regard. They have the ability to carry the maximum tractive effort to speeds, two or more times that of the steam locomotives.

To better understand what has been covered in the foregoing discussion, an actual comparison has been made of the tractive effort and the horsepower of a steam and an electric locomotive of equal weights, both designed for heavy passenger service over mountain grades. The data of weights, etc., is given in the table. The steam locomotive is of the very latest design, embodying arch tubes and superheater.* The locomotive is designed to carry a boiler pressure of 200 lb., which together with cylinders of 28 in. diameter and 30 in. stroke, result in the very large rated tractive effort of 58,000 lb. The electric locomotive is one of the latest, built for heavy mountain passenger service.

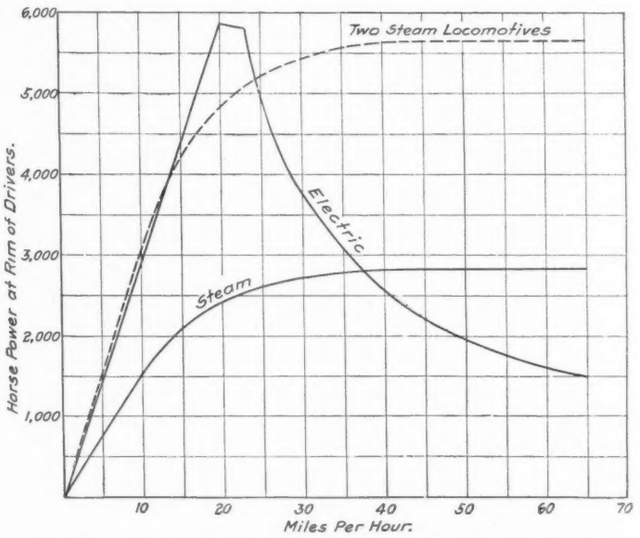


Fig. 2—Comparison of Horsepower of Steam and Electric Locomotives of the Same Weight Operating at Various Speeds

The first comparison made is that of tractive effort. Curves showing the relation between speed and tractive effort for the two types are shown in Fig. 1. The maximum tractive effort of the steam locomotive is 58,000 lb., while that of the electric is 110,000 lb. Reference to the data in the table shows that the weight on the drivers is 330,000 lb., so that the 110,000 lb. tractive effort for starting is based on 30 per cent adhesion, a conservative value for the electric locomotive. This maximum tractive effort in the case of the electric locomotive is carried out to a speed of 20 miles per hour, while the steam locomotive cannot maintain its maximum beyond 10 miles per hour. The electric locomotive curve drops rapidly, and at 38 miles an hour both types are the same. To better appreciate what this large tractive effort of the electric locomotive means, a curve has been drawn in, showing what the tractive effort would be for two steam locomotives operating as a double-header. The dotted curve is slightly higher for the maximum tractive effort, but in practical work the one electric could start the same train as the two steam locomotives, and would have an advantage over them up to a speed of 24 miles an hour. When it is considered that on heavy passenger mountain service, speeds do not greatly exceed this figure, it becomes clear that the one electric locomotive is nearly equivalent to the two steam locomotives.

*The U. S. R. A. standard heavy Mountain type.

It must be remembered that the two steam locomotives could maintain this speed continuously with a tractive effort of 80,000 lb., while the electric locomotive could not on account of the electric motors requiring a current much above the continuous rating.

Since horsepower is such an important factor, Fig. 2 has been drawn, showing the relative horsepower for the two engines chosen. Here the comparison is even more striking, and the great advantage of the electric locomotive is easily recognized. This electric locomotive of the same weight as the steam, has a maximum developed hp. rating at the rims of the drivers of 5,860 hp. compared to 2,825 hp. for the steam locomotive. And when compared with two steam locomotives it shows, for the working range, the ability to deliver the equivalent in hp. Of course, the continuous

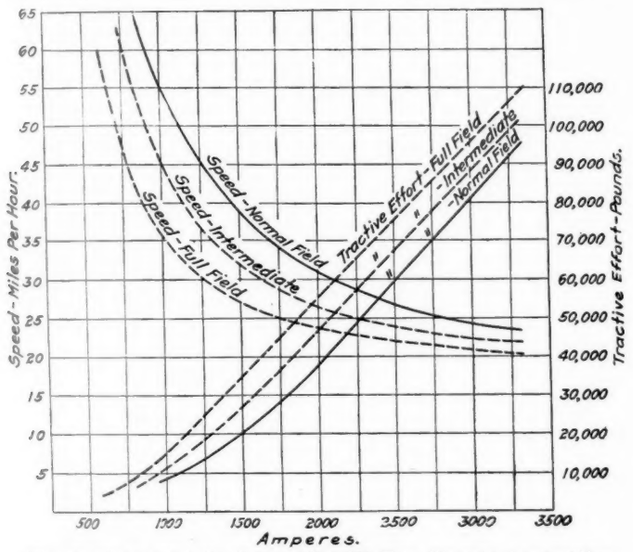


Fig. 3—Characteristic Curves for 266-Ton Electric Locomotive

rating must not be lost sight of, and for the electric locomotive this is 3,200 hp. The increase in horsepower is due to the increased speed for the same tractive effort. Referring to Fig. 1, assume there is a passenger train requiring at certain sections or grades, a tractive effort varying from 50,000 lb. to 40,000 lb. At 50,000 lb., the speed of the steam locomotive would be 16½ miles per hour—the electric, 29 miles per hour—nearly double. At 40,000 lb., the steam

COMPARISON OF STEAM AND ELECTRIC LOCOMOTIVES OF EQUIVALENT WEIGHTS

Characteristics	Steam	Electric
	4-8-2	4-6-2—2-6-4
Weight—engine and 14-ton tender	268.5 tons	266 tons
Weight—engine only	352,000 lb.	532,000 lb.
Weight—engine on drivers	243,000 lb.	330,000 lb.
Number of pairs of drivers	4	6
Weight per pair	60,500 lb.	55,000 lb.
Wheel diameter, inches	69	68
Total wheel base engine and tender	75 ft. 8.5 in.	79 ft. 10 in.
Maximum tractive effort	58,000	110,000
Maximum horse power	2,825	5,860
Continuous horse power	2,825	3,200

locomotive would be 24.5 miles per hour—the electric, 32.

Characteristic curves showing the relation between speed, tractive effort and the current taken by the locomotive, are supplied by the electrical manufacturers. The set of curves for the electric locomotive under consideration are shown by Fig. 3. From these curves the tractive effort at any speed can be read off directly. It is noted there are three speed curves and three tractive effort curves corresponding. This locomotive uses "field controls," thus reducing resistance losses. The tractive effort and horsepower curves covered the "normal field condition." To show, briefly, what is gained with this field control, consider the continuous horsepower rating of 3,200 hp. With normal field this corresponds to a speed of 34 miles an hour and a tractive effort of 35,000 lb. If a greater tractive effort is necessary continuously the speed can be reduced by operating on full field when a speed of 24.5 miles per hour is obtained at a tractive effort of 49,000 lb.

ANNUAL REPORT OF THE I. C. C. LOCOMOTIVE INSPECTION BUREAU

The seventh annual report of the chief inspector of locomotive boilers for the fiscal year ended June 30, 1918, covers the work done under the locomotive-boiler inspection act as amended to apply to the entire locomotive and tender and all their parts and appurtenances.

TABLE I—LOCOMOTIVES INSPECTED, NUMBER FOUND DEFECTIVE, AND NUMBER ORDERED OUT OF SERVICE

	1918	1917	1916
Number of locomotives inspected	41,611	47,542	52,650
Number found defective	22,196	25,909	24,685
Percentage found defective	53	54.5	47
Number ordered out of service	2,125	3,294	1,943

Table I shows, in concrete form, the number of locomotives inspected, the number and percentage found defective, and the number ordered out of service on account of not

TABLE II—NUMBER OF ACCIDENTS, NUMBER KILLED, AND NUMBER INJURED, BY COMPARISON

	1918	1917
Number of accidents	641	616
Increase over previous year.....per cent..	4.1	...
Number killed	46	62
Decrease from previous year.....per cent..	25.8	...
Number injured	756	721
Increase over previous year.....per cent..	4.8	...

meeting the requirements of the law. Table II shows the total number of accidents due to failure from any cause of locomotives or tenders and all parts and appurtenances thereof and the number killed and injured thereby.

Table III shows the total number of persons killed and injured by failure of locomotives or tenders, or any part of appurtenance thereof, during the three years ended June 30, 1916-1918, classified according to occupations.

A summary of the accidents and casualties resulting therefrom during the year shows an increase of 4.1 per cent in the number of accidents, with a decrease of 25.8 per cent in the number killed, and an increase of 4.8 per cent in the number injured.

The decrease in the number of locomotives inspected during the year is due to the fact that a substantial percentage of the inspectors of locomotives were engaged in special work during most of the year. During the months of November and December, 1917, almost all of the inspectors were engaged, at the request of the Interstate Commerce Commission, in checking the congestion at terminals in an effort to see that locomotives were promptly furnished so that the coal movement might be facilitated and the fuel shortage relieved; and during the months of January, February, and March, 1918, were performing similar work at the request of the director general of railroads, and this work contributed materially toward breaking the blockade and expediting the movement of coal and other freight. It is also due in part to the fact that a number of inspectors of locomotives were permanently transferred to the service of the director general of railroads because of their general knowledge of equipment and their training in conducting investigations.

The period covered by this report represents what is admitted to have been the most difficult in the history of American railroads to properly maintain locomotives. This is primarily due to the war conditions which made it necessary to use to their maximum capacity all locomotives that were serviceable, and to return to service many locomotives

that had been out of service for years awaiting disposition and which, in some cases, were put in service without having been thoroughly repaired. Proper maintenance of locomotives was also made difficult by the large number of mechanics that entered military service. The excessive demands for power resulted in the use of many locomotives that were in violation of federal laws, but the results of this practice were clearly demonstrated during the past winter.

These conditions rendered the work of the inspectors exceedingly difficult, and considerable pressure from various sources was brought to bear on them to prevent the enforcement of the law where locomotives were sorely needed. The shortage of power made it necessary in every case for inspectors to exercise the utmost good judgment and discretion in their work in order to avoid any possibility of causing additional congestion which an inflexible enforcement of the law might have brought about. The fact that the enforcement of the locomotive inspection laws during this trying period did not unnecessarily hamper the movement of traffic, but on the contrary the work of the inspectors, in hundreds of instances, facilitated the operation of locomotives and the movement of trains, is evidence not only of the discretion and judgment of inspectors in their enforcement of the law, but also of the wisdom and farsightedness of its framers, because it is generally admitted that the law and the work of the inspection bureau was of substantial benefit during the past winter, and when we consider, in addition to this, the fact that the general condition of locomotives has improved during the year, due, in part, to the work of the inspectors, the results become particularly creditable.

TABLE III—THREE-YEAR COMPARISON OF CASUALTIES CAUSED BY FAILURE OF LOCOMOTIVES, TENDERS AND APPURTENANCES, CLASSIFIED BY OCCUPATIONS

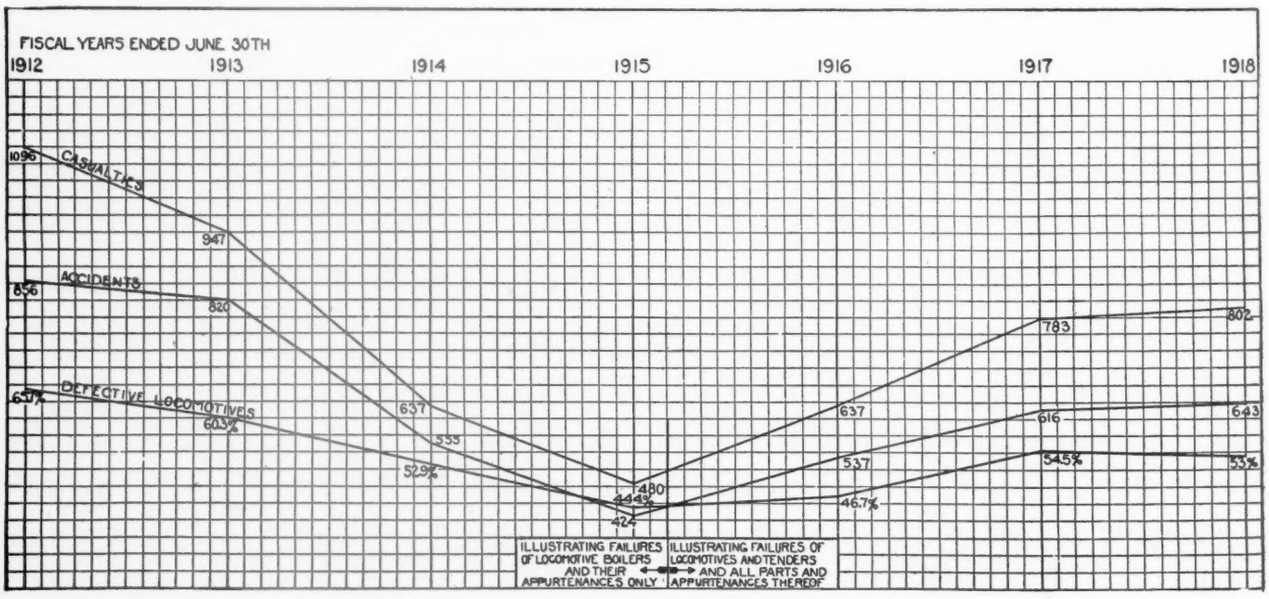
	1918		1917		1916	
	Killed	Injured	Killed	Injured	Killed	Injured
Members of train crews:						
Engineers	11	245	16	230	11	205
Firemen	19	306	21	304	12	225
Brakemen	6	62	13	60	9	74
Conductors	..	21	3	14	1	6
Switchmen	2	8	1	8	..	6
Roundhouse and shop employees:						
Boiler makers	1	11	...	11	1	11
Machinists	..	11	...	8	1	11
Foremen	1	4	...	1	1	3
Inspectors	4	4	...	3	...	3
Watchmen	..	3	...	5	...	8
Boiler washers	..	4	...	7	...	10
Hostlers	..	8	...	6	...	6
Other roundhouse and shop employees	2	19	2	19	1	21
Other employees	..	26	5	22	...	7
Non-employees	..	24	1	23	1	3
Total	46	756	62	721	38	599

During the year 353 applications were filed for extension of time for removal of flues under the provisions of Rule 10. Investigation showed 18 of these locomotives in such condition that no extension could properly be granted. Forty-two were in such condition that the full extension requested could not be granted, but an extension for a shorter period was allowed. Thirteen extensions were granted after defects disclosed by our inspectors had been repaired. Sixty-two applications were withdrawn for various reasons, and the remaining 218 were granted for the full period asked for. It will be noted that the number of applications for extension of time for removal of flues decreased about 50 per cent. This is largely due to the modification of the rule which was recommended to the Commission and approved by it.

As provided in Rule 54, 3,124 specification cards and 8,080 alteration reports were filed.

The locomotive headlight case, which has been pending for approximately three years, was finally disposed of June 7, 1918, by the withdrawal by the complainant and at the complainant's cost, of bill in equity No. 226, United States District Court, District of Indiana, *New York Central Railroad Co.* v. *United States,* in which it was sought to restrain the Interstate Commerce Commission from enforcing its order. This withdrawal was made after arguments on the bill had been heard by the court and the position of the complainants declared to be unsound.

In the sixth annual report recommendations were made that locomotives should be equipped with automatic fire doors and that a steam connection to air-operated power reverse gear should be applied. It is not considered necessary to repeat these recommendations at this time for the reason that both recommendations have been adopted by the United States Railroad Administration, and all standard United States locomotives are being so equipped, and it is expected that these recommendations will be generally followed on locomotives passing through the shop for general repairs, so far as material and labor are available.



Relation of Defective Locomotives to Accidents and Casualties Resulting from Locomotive Failures.

STANDARD EQUIPMENT SPECIALTIES

The Distribution, by Classes of the Special Equipment Used on Government Cars and Locomotives

THE specialties applied to the standard cars and locomotives built for the Railroad Administration have been published in the *Railway Mechanical Engineer* from time to time during the year. In order to give a better idea of the distribution of the use of these specialties among the various classes of equipment the accompanying tables have been compiled. A few minor changes were made in the original lists showing the distribution of the orders, primarily on account of delivery.

The companies receiving orders for the specialties for the locomotives are shown in the table under the various specialty items and on which class of power these specialties are used. In case one specialty is used on all locomotives, such as the American Arch Company arch, it is so designated.

The table showing the specialties for the cars includes only those for the cars which have been built thus far, as information is not obtainable as to just which of the specialties will be applied to the other cars.

SPECIALTIES FOR THE STANDARD LOCOMOTIVES

	All locomotives	Mikado		Mountain		Pacific		Santa Fe		Switcher		Mallet	
		Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy	0-6-0	0-8-0	2-6-6-2	2-8-8-2
Air Brake—													
Westinghouse Air Brake Co.	...	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
New York Air Brake Co.	...	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Arch—													
American Arch Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bell Ringer—													
Harry Vissering & Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Blow-off Cock—													
Everlasting Valve Co.	...	Yes	Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes
Southern Loco. Valve Gear Co.	...	No	Yes	No	No	No	No	Yes	No	No	Yes	No	No
Okadee Co.	...	Yes	No	No	No	No	No	No	Yes	Yes	No	Yes	Yes
Blower Fitting—													
Barco Manufacturing Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bolster—Tender Truck—													
Pittsburgh Steel Foundries	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Brake—													
American Brake Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Brake Beams—Tender Truck—													
Chicago Railway Equip. Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Brake Beam Support—													
Chicago Railway Equip. Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Brake Cylinder Expander Ring—													
H. W. Johns-Manville Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Brake Shoes—													
American Brake Shoe & Foundry Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Buffer—Radial—													
Franklin Railway Supply Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bumper—Front—													
Commonwealth Steel Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Bushings—Cylinder and Valve—													
Hunt-Spiller Mfg. Corp.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Cellars—Driving Box—													
Franklin Railway Supply Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Coal Pusher—													
Locomotive Stoker Co.	...	No	No	No	No	Yes	No	No	No	Yes	Yes	No	No
Coupler—													
National Mall. Cast. Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Coupler Yoke—													
Buckeye Steel Castings Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Crosshead Shoes—													
Hunt-Spiller Mfg. Corp.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Draft Gear—													
Westinghouse Air Brake Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Dust Guards—													
W. N. Thornburg Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Fire Door—													
Franklin Railway Supply Co.	...	No	Yes	No	No	No	No	Yes	Yes	No	Yes	No	No
National Railway Device Corp.	...	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Frame—Tender—													
Commonwealth Steel Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Frame—Tender Truck Side—													
American Steel Foundries	...	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Buckeye Steel Castings Co.	...	Yes	Yes	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Gages—Steam—													
Ashcroft Mfg. Co.	..	Yes	Yes	No	Yes	No	No	No	Yes	Yes	No	No	Yes
Ashton Valve Co.	...	No	Yes	Yes	No	Yes	Yes	Yes	No	No	Yes	Yes	No
Gages—Steam Heat—													
Ashton Valve Co.	...	No	No	Yes	Yes	Yes	Yes	No	No	No	No	No	No
Gages—Water—													
Sargent Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Gage Cocks—													
Nathan Mfg. Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Grate Shaker—													
Franklin Railway Supply Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Headlight Case—													
Schroeder Headlight & Gen. Co.	...	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No
Handlon & Buck Mfg. Co.	...	Yes	Yes	No	No	No	No	No	No	No	No	Yes	Yes
Adams & Westlake Co.	...	No	No	No	No	No	No	No	No	Yes	No	No	No
Headlight Equipment—													
Pyle National Co.	...	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Schroeder Headlight & Gen. Co.	...	No	Yes	Yes	No	Yes	Yes	No	Yes	Yes	No	No	No
Injectors—													
Nathan Mfg. Co.	...	Yes	Yes	No	No	No	No	No	No	Yes	No	Yes	No
Hancock Inspirator Co.	...	No	Yes	Yes	Yes	Yes	Yes	No	Yes	No	Yes	No	Yes
Ohio Injector Co.	...	No	No	No	No	No	No	Yes	No	No	No	No	No
Joints—Metallic Pipe—													
Barco Manufacturing Co.	...	No	Yes	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Franklin Railway Supply Co.	...	Yes	No	No	No	No	No	No	No	Yes	Yes	No	No
Greenlaw Mfg. Co.	...	Yes	No	Yes	Yes	No	No	No	No	No	No	No	No
Lubricator—													
Nathan Mfg. Co.	...	Yes	Yes	No	No	No	No	No	No	No	Yes	Yes	Yes
Detroit Lubricator Co.	...	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No
Lubricator—Driving Box—													
Franklin Railway Supply Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Oil Cups—Guide, Piston Rod, Valve Stem—													
Hancock Inspirator Co.	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

	All loco-motives	Mikado		Mountain		Pacific		Santa Fe		Switcher		Mallet	
		Light	Heavy	Light	Heavy	Light	Heavy	Light	Heavy	0-6-0	0-8-0	2-6-6-2	2-8-8-2
Packing—Piston & Valve Rod—													
United States Metallic Pack. Co	...	Yes	Yes	No	No	No	Yes	No	No	Yes	No	No	No
Paxton-Mitchell Co.	...	No	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes	Yes	Yes
Packing Rings—Cylinder and Valve—													
Hunt-Spiller Mfg. Corp	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Reverse Gear—													
Ragonnet (Frank. Ry. Sup. Co.)	...	Yes	No	No	Yes	Yes	Yes	Yes	No	Yes	Yes	No	Yes
Lewis (Commonwealth Sup. Co.)	...	No	Yes	Yes	No	No	No	No	Yes	No	No	Yes	No
Mellin (Am. Loco. Co.)	...	No	No	No	No	No	No	No	No	Yes	No	No	No
Brown (Sou. Loco. Valve Gear Co.)	...	No	No	No	No	No	No	No	No	No	Yes	No	No
Safety Bar (Unit)—													
Franklin Railway Supply Co	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sanders—													
U. S. Metallic Packing Co	...	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes
Hanlon Loco. Sander Co	...	Yes	Yes	Yes	No	No	No	Yes	Yes	No	No	No	No
Harry Vissering & Co	...	No	No	No	No	Yes	Yes	No	No	No	No	No	No
Side Bearing—Tender—													
E. S. Woods & Co	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Springs—													
Crucible Steel Co	...	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	No	Yes
Ft. Pitt Spring & Mfg. Co	...	No	Yes	No	No	No	No	No	Yes	Yes	No	Yes	Yes
Pittsburgh Spring & Steel Co	...	Yes	No	No	No	Yes	No	No	Yes	No	No	No	No
Railway Steel Spring Co	...	Yes	Yes	No	No	No	No	No	No	Yes	No	No	No
Standard Steel Works	...	Yes	Yes	Yes	Yes	Yes	No	No	No	No	Yes	No	No
Union Spring & Mfg. Co	...	Yes	Yes	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Sprinkler—													
Wm. Sellers Co., Inc	...	Yes	Yes	Yes	Yes	No	No	No	No	No	No	No	No
Hancock Inspirator Co	...	No	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Stoker—													
Locomotive Stoker Co	...	Yes	No	No	No	No	Yes	Yes	No	No	No	No	Yes
Standard Stoker Co	...	No	Yes	Yes	Yes	No	No	No	No	No	No	Yes	No
Hanna Loco. Stoker Co	...	No	No	No	No	No	No	No	Yes	No	No	No	No
Superheater—													
Locomotive Superheater Co	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Throttle Valve—													
Chambers Valve Co	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Truck—Trailer—													
Hodges (Baldwin Loco. Works)	...	Yes	No	No	No	No	No	No	No	No	No	No	No
Cole-Scoville (Am. Loco. Co.)	...	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Uncoupling Device—													
Imperial Appliance Co	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Valves—Blower—													
Sargent Company	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Valve Gear—													
Walschaert	...	Yes	Yes	No	No	No	No	No	No	No	No	No	No
Pilliod Co. (Baker)	...	No	No	Yes	Yes	Yes	Yes	No	No	Yes	Yes	Yes	Yes
Southern Loco. Valve Co	...	No	No	No	No	No	No	Yes	Yes	No	No	No	No
Valve—Check—													
Nathan Mfg. Co	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Valve—Piston—													
American Balanced Valve Co	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Valve—Safety—													
Consolidated Safety Valve Co	...	Yes	Yes	Yes	Yes	Yes	Yes	No	No	No	Yes	No	No
Coale Muffler & Safety Valve Co	...	No	Yes	No	No	No	No	Yes	No	Yes	No	Yes	No
Ashton Valve Co	...	No	No	No	No	No	No	No	Yes	No	No	No	Yes
Valve—Steam Heat—													
Vapor Car Heating Co., Inc	...	No	No	Yes	No	Yes	No	No	No	No	No	No	No
Leslie Co.	...	No	No	No	Yes	No	Yes	No	No	No	No	No	No
Ventilator—Cab—													
Rushton (Bald. Loco. Works)	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wheels—Rolled Steel—													
Forged Steel Wheel Co	...	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes
Standard Steel Works	...	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	No	No	Yes	Yes

SPECIALTIES FOR STANDARD CARS THUS FAR BUILT

	D. S. Box	S. S. Box	Comp. Gon.	55-Ton Hopper	L. S. Gon.
Angle Cock Holders—					
Western Railway Equipment Co	Yes	Yes	Yes	Yes	Yes
Bearing, Journal—					
Magus	Yes	Yes	Yes	Yes	Yes
Keystone	Yes	Yes	Yes	Yes	Yes
Haskel & Barker	Yes	Yes	Yes	Yes	No
Ajax	Yes	Yes	Yes	Yes	Yes
Bostwick & Lyons	Yes	Yes	Yes	Yes	No
Bearings, Lick Frictionless—					
Wine Railway Appliance Co	Yes	No	Yes	No	No
E. S. Woods & Co	No	Yes	Yes	No	No
A. Stucki Co	No	No	Yes	Yes	Yes
Bolsters, Truck—					
American Steel Foundries	Yes	Yes	Yes	Yes	Yes
Buckeye Steel Castings Co	Yes	Yes	Yes	Yes	Yes
Gould Coupler Co	Yes	Yes	Yes	Yes	No
Scullin Steel Co	Yes	Yes	Yes	Yes	No
Bettendorf Co.	No	Yes	Yes	Yes	No
Boxes, Journal—					
National Mall. Cast. Co	Yes	Yes	Yes	Yes	Yes
Gould Coupler Co	Yes	Yes	Yes	Yes	Yes
American Mall. Cast. Co	Yes	Yes	Yes	Yes	No
Union Spring & Mfg. Co	Yes	Yes	Yes	Yes	Yes
T. H. Symington Co	Yes	Yes	Yes	Yes	No
Brakes, Air—					
New York Air Brake Co	Yes	No	No	No	No
Westinghouse Air Brake Co	No	Yes	Yes	Yes	Yes
Brake Beams, Tender—					
Buffalo Brake Beam Co	Yes	Yes	No	Yes	No
Davis Brake Beam Co	Yes	No	Yes	Yes	Yes
American Steel Foundries	Yes	No	Yes	No	No
Joliet Railway Equipment Co	Yes	Yes	Yes	Yes	No
Damascus Brake Beam Co	Yes	No	Yes	Yes	No
Haskell & Barker	Yes	Yes	Yes	No	No
Pressed Steel Car Co	Yes	No	No	Yes	Yes
Chicago Railway Equipment Co	No	Yes	Yes	Yes	No
Brake Shoes—					
American Brake Shoe & Fdry. Co.	Yes	Yes	Yes	Yes	Yes
Couplers—					
American Steel Foundries	Yes	Yes	Yes	Yes	Yes
Buckeye Steel Casting Co	Yes	Yes	Yes	Yes	Yes
Gould Coupler Co	Yes	Yes	Yes	Yes	Yes
McConway & Torley	Yes	Yes	Yes	Yes	Yes
National Mall. Cast. Co	Yes	Yes	Yes	Yes	Yes

	D. S. Box	S. S. Box	Comp. Gon.	55-Ton Hopper	L. S. Gon.
Davis' 3d Point Suspension—					
Chicago Railway Equipment Co	Yes	Yes	Yes	Yes	Yes
Door Fixtures (Slide)—					
Camel Company	No	Yes	No	No	No
Draft Gear, Friction—					
Westinghouse Air Brake Co	Yes	Yes	Yes	Yes	Yes
Standard Coupler Co	Yes	Yes	Yes	Yes	Yes
Union Draft Gear Co	Yes	Yes	Yes	Yes	Yes
Keyoke Railway Equipment Co	Yes	Yes	Yes	Yes	Yes
Dust Guards—					
Wm. N. Thornburgh Co	Yes	Yes	Yes	Yes	Yes
Ends, Pressed Steel—					
Pressed Steel Mfg. Co	Yes	Yes	Yes	No	No
Chicago & Cleveland Car Roof Co	No	No	Yes	No	No
Frames, Truck—					
American Steel Foundries	Yes	Yes	Yes	Yes	Yes
Bettendorf Co.	Yes	Yes	Yes	Yes	No
Buckeye Steel Cast. Co	Yes	Yes	Yes	Yes	Yes
Gould Coupler Co	Yes	Yes	Yes	Yes	No
Scullin Steel Co	Yes	Yes	Yes	Yes	No
Hose, Air Brake—					
New York Air Brake Co	Yes	No	No	No	No
Westinghouse Air Brake Co	No	Yes	Yes	Yes	Yes
Uncoupling Device—					
Imperial Appliance Co	Yes	Yes	Yes	Yes	Yes
Wedges, Journal Box—					
Western Railway Equipment Co	Yes	Yes	Yes	Yes	Yes
Wheels, Cast Iron—					
Brass Foundry & Machine Co	Yes	Yes	Yes	Yes	No
Louisville Car Wheel & Supply Co.	Yes	Yes	Yes	No	No
Albany Car Wheel Co	Yes	Yes	Yes	No	No
Southern Car Wheel Co	Yes	Yes	Yes	Yes	No
New York Car Wheel Co	Yes	Yes	Yes	No	No
Ramapo Car Wheel & Foundry Co	Yes	Yes	Yes	Yes	No
Buffalo Car Wheel & Foundry Co.	Yes	Yes	Yes	Yes	No
Brown Car Wheel Works	Yes	Yes	Yes	No	No
Griffin Car Wheel Works	Yes	Yes	Yes	Yes	Yes
Western Steel Car Co	Yes	Yes	Yes	No	No
Standard Car Wheel Co	Yes	Yes	Yes	No	No
National Car Wheel Co	Yes	Yes	Yes	Yes	No
Wheels, Steel—					
Standard Forged Steel	No	No	No	Yes	Yes
Pressed Steel (Carnegie)	No	No	No	Yes	Yes
Yokes, Draw Bar—					
Buckeye Steel Castings Co	Yes	Yes	Yes	Yes	Yes
Union Draft Gear Co	Yes	Yes	Yes	Yes	Yes

LINING AND FLOOR RACKS FOR CARS HANDLING PERISHABLE FREIGHT

The car service section of the Railroad Administration issued Circular CS-43 (revised), dated January 30, covering the use of refrigerator and box cars to be used in the transportation of perishable freight.

Refrigerator Cars.—(1) Railroads will supply refrigerator cars for shipment of fruits and vegetables to the extent of their ability. A certain percentage of this class of cars belonging to the various railroads is already equipped with false floors or floor racks. It is contemplated eventually to equip in this manner all such cars owned by roads under federal control, and also cars of the following refrigerator lines: Pacific Fruit Express Company, Santa Fe Refrigerator Despatch, American Refrigerator Transit Company and the 'Frisco Refrigerator Line.

RETURN TO

.....

(Insert name of shipper.)

AT

.....

(Name of station.)

..... RAILROAD

(Name.)

UNITED STATES RAILROAD ADMINISTRATION

Instruction Card for Return of Cars

2. It will not be practicable for the railroads to equip a sufficient number of cars to fully meet the requirements of the present season. Therefore, if refrigerator cars owned by federal-controlled roads, or cars belonging to any of the above named refrigerator lines, not equipped with floor racks, are offered for loading fruit and vegetables, shippers, if they so desire, will be privileged to construct and place in cars suitable racks of standard type, in accordance with specifications shown on accompanying print. Racks when so placed will become a permanent part of the car.

3. Railroads will reimburse shippers for the value of floor racks placed as above described at the rate of fifty cents per linear foot of rack. This reimbursement will be made by the road on which load is first placed in car following installation of floor racks.

4. Any *lining* desired by shippers in refrigerators in addition to floor racks must be placed by them at their own expense, and in such manner as not to damage the car or insulation.

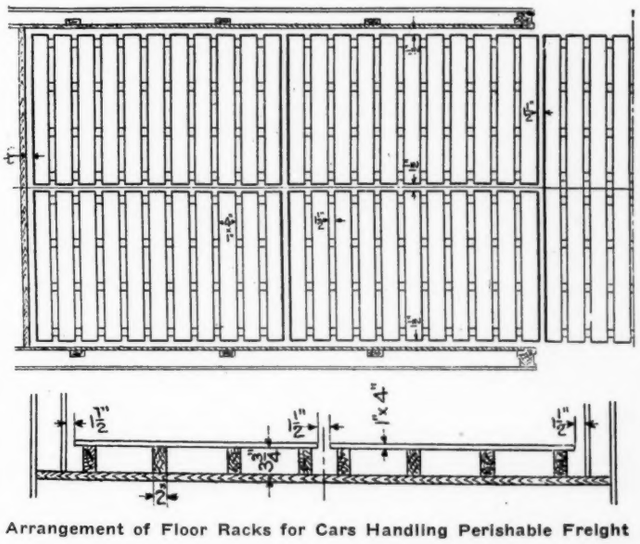
Box Cars.—(5) When railroads are unable to meet the demand for refrigerator cars for above named shipments, if shippers elect to make use of box cars, and if in their opinion such cars require lining, they (the shippers) will be given the privilege of equipping the cars with such lining entirely at their own expense.

6. In the interest of promoting shipments and conserving food supply, it is suggested that the lining of box cars, when done, conform to the following standard furnished by the Bureau of Markets, United States Department of Agriculture, which, it is believed, will give the best results:

"False floors, side and end walls shall be installed providing an unobstructed space for air circulation down between the car and walls and false end walls, and from there under the false floors to the doorways. This ventilating space must be kept clear of hay, straw, manure, shavings, and everything except the necessary false-floor supports. There shall be a space between the car side walls and the false side walls of not less than four inches at the top and six inches at the bottom.

"Each doorway shall be tightly boarded not less than 24 in. from the floor upward, the boards being nailed to the inside of the door frame to keep out cold winds."

7. For the same reason it is further requested that shippers make it a practice to use box cars for the shorter hauls, reserving refrigerator cars for loading to the more distant points. Railroads will supply refrigerator cars preferentially as compared with box cars, for the longer runs.



Arrangement of Floor Racks for Cars Handling Perishable Freight

8. Box cars that may be lined by shippers will be furnished with a board on either side, of uniform dimensions (24 in. by 30 in.), with lettering of suitable size, reading as shown in the illustration.

9. These boards will be furnished by the railroads. Lined box cars so boarded will be returned free, with lining, to point of origin of load, and should be waybilled to such point, consigned to party or firm whose name the board bears. They may be loaded all or a part of the way

on return trip with any suitable freight. They must not be loaded out of direct line, and care should be exercised to avoid damage to lining in loading or unloading.

10. It must be understood that cars thus lined and boarded are subject to demurrage, either while awaiting loading or unloading.

11. The privilege of equipping box cars as above will extend from November 15, 1918, to April 1, 1919. In the event of failure to return lining to shippers within three months from the last named date, roads on which it was originally placed in cars will refund to party furnishing same the sum of twenty-five dollars per car in full payment for the value of the lining, but only when installed in conformity with the specifications named in paragraph 6. In the case of box cars the term "lining" will be understood as including false floor as well as lining of side and end walls.

12. Roads on which cars are equipped should keep an accurate account, showing date, number and initial of car and name of shipper to avoid any misunderstanding in making settlement in case of loss.

13. After April 1, shippers will be required to promptly remove from cars any lining which belongs to them. Failing to remove such equipment, the work of removal will be performed by the railroads, but the latter will not be responsible to owners for the material or its value after removal.

14. Provisions herein contained which relate to reimbursements to be made to shippers become effective coincidentally with the effective date of tariff provisions of the various railroads authorizing such reimbursement.

JOURNAL BOX PACKING

In response to an inquiry for information regarding the use of substitutes for journal box packing, published in the *Railway Mechanical Engineer* a short time ago, several roads have replied. A brief abstract of the replies follows:

Road A.—We have experienced some trouble in using the cotton journal box packing. It has been found to be short material and has not been giving us the service that we should receive. We have been using cotton packing on freight equipment for some time, but the past year we have had a very poor grade of material.

Road B.—This company has been using cotton waste for journal box packing for some period of time, and we find that if it is kept up to the journal we have no trouble. This waste is inclined to sag a little more than good wool and requires a little more attention. We have been very successful with its use.

Road C.—We did not change our practice during the war but used cotton waste for packing all journal boxes, which has been the practice on this line for the past fifteen years.

Road D.—We have to date made no changes from our pre-war practice. We are using cotton waste for freight cars and a 75 per cent wool and 25 per cent merino waste for passenger cars and tender trucks. We have obtained very satisfactory results.

Road E.—We have not made any changes in our standards for journal box packing. We use cotton waste for packing journal boxes of freight cars and a composite wool cotton and fibre waste for passenger cars and locomotives.

Road F.—It has always been the practice of this road to use wool waste for passenger car journal box packing and a journal box packing composed of wool waste and cocoanut fibre for freight equipment cars. We have not deviated from this practice during the past year, but we have frequently been furnished with wool waste which was of inferior quality to that called for in our specification and were often obliged to take this material, although we did not consider it satisfactory for journal box packing.

The following is taken from our specifications for journal box packing: The material desired under Grade A is curled vegetable fibre, so curled as to impart to it the maximum resiliency; wool and cotton threads free from large lumps of any one component part and thoroughly machined and intimately mixed with the curled fibre in the following proportions, Grade B to have the same quality of wool and cotton as Grade A, without the vegetable fibre.

	Grade A	Grade B
a. Vegetable fibre	15 per cent	0 per cent
b. Wool waste	45 per cent	60 per cent
c. Cotton waste	40 per cent	40 per cent

The vegetable fibre should be Tampico, cocoanut or some approved equivalent, clean, long, strong, well curled and sufficiently elastic. The wool threads should consist of new yarn or thrums from the product of looms weaving Brussels, Axminster and Ingrain carpets and other high-grade woolen fabrics. Muck yarn shall not be used. The cotton waste should consist of white and colored new cotton threads.

Road G.—We have tried several substitutes for wool, but have not been able to secure satisfactory results and have insisted on and secured a journal box packing to the following specification: A shredded carpet stock containing at least 50 per cent net wool content, the balance of the mixture composed of cotton and long merino threads, 2 inches and over. The whole being well machined, free from knots, flyings, jute, sticks, paper or other deleterious substances. Oil, grease and dirt not more than 10 per cent. Moisture not to exceed 10 per cent. Cotton not more than 20 per cent. This is proving very satisfactory.

Road H.—This road has tested, in service, a number of different kinds of journal box packing and our tests indicate that a combination of wool, cotton and vegetable fibre gives the best results. The standard packing now used by this company consists of about 85 per cent wool, 7 to 8 per cent cotton and 7 to 8 per cent vegetable fibre.

Road I.—We have for several months on this road been using wool waste, which is partially made up of shredded carpet. This waste is composed of approximately 67 per cent wool and 33 per cent cotton, and is satisfactory.

Road J.—While a good grade of packing is, of course, better than a poor grade, I believe that 90 per cent of the hot box trouble could be eliminated with the average packing that is used if boxes were given the proper attention. Two of the main troubles have been, first, allowing cars to run until the packing at the back of the journal became dry and glazed; also in extremely cold weather the packing works to the front of the boxes reducing the surface of the journal which is lubricated until the hot box is unavoidable. Second, rebrassing cut journals instead of changing wheels.

The greatest advance that has been made in years in the prevention of hot boxes has been in the discovery that where lubrication is failing or friction is increasing from any cause, the center of the journal on the end becomes dry before the journal becomes hot. A dry journal center is almost an infallible sign of an impending hot box and calls for one of three actions (always examine brass and journal):

1. If caused by dry and glazed dope, with brass and journal in good condition, repack box.
2. If the brass is worn or defective with the journals in good condition, rebrass and repack.
3. If the journal is cut, change the wheels.

Where there is a plug of waste in the front end of the box (I think these will soon all be removed by all roads), a dry spot cannot, of course, develop; but frequently a greasy wheel with a new brass is an indication that a brass has been applied to a cut journal. This journal may run cool if the car is empty, but not when it is loaded.

One cause of an unnecessary number of hot boxes is the practice of applying brasses to cut journals when the wheels should have been removed. This was quite general a year ago, and there has been a great deal of it up until the last

few months. A car stops off at various sidings and repair tracks to have brasses changed and thus takes several weeks to get over the road, and it is very difficult to learn what is going on until some person complains of the long delay to a car of important freight. I am fully convinced that if all roads followed these matters closely the hot boxes could be reduced 90 per cent.

We have spread our wheel storage tracks and cut the sides of our wheel cars down so that wheels can be stored without the flanges of the wheels striking against the journals.

A feature in connection with changing or examining the brass is the importance of using two jacks. When only one jack is used the weight on the opposite journal, especially if the car is loaded, usually causes the wheel to raise from the rail with the result that the man usually goes for help and has to use blocks to force the wheel down. In many cases this makes it necessary to drive the brass in with a bar or hammer, damaging the lining as it is forced past the collar and sometimes when there has been end wear on the brass removed, the new brass and wedge are not properly seated, resulting in a brass bearing on one end with the certainty of a hot box.

If a jack is placed under the opposite box and raised just enough to take the weight, the wheels remain on the rail; also if the brass removed is end worn the wheels, being free on the rail, can easily be moved over to allow the new brass to enter. I have seen three or four men take an hour to change a brass with one jack where one man could have done the work in a few minutes with two jacks.

AUTOMOBILE CARS FOR THE I. C.

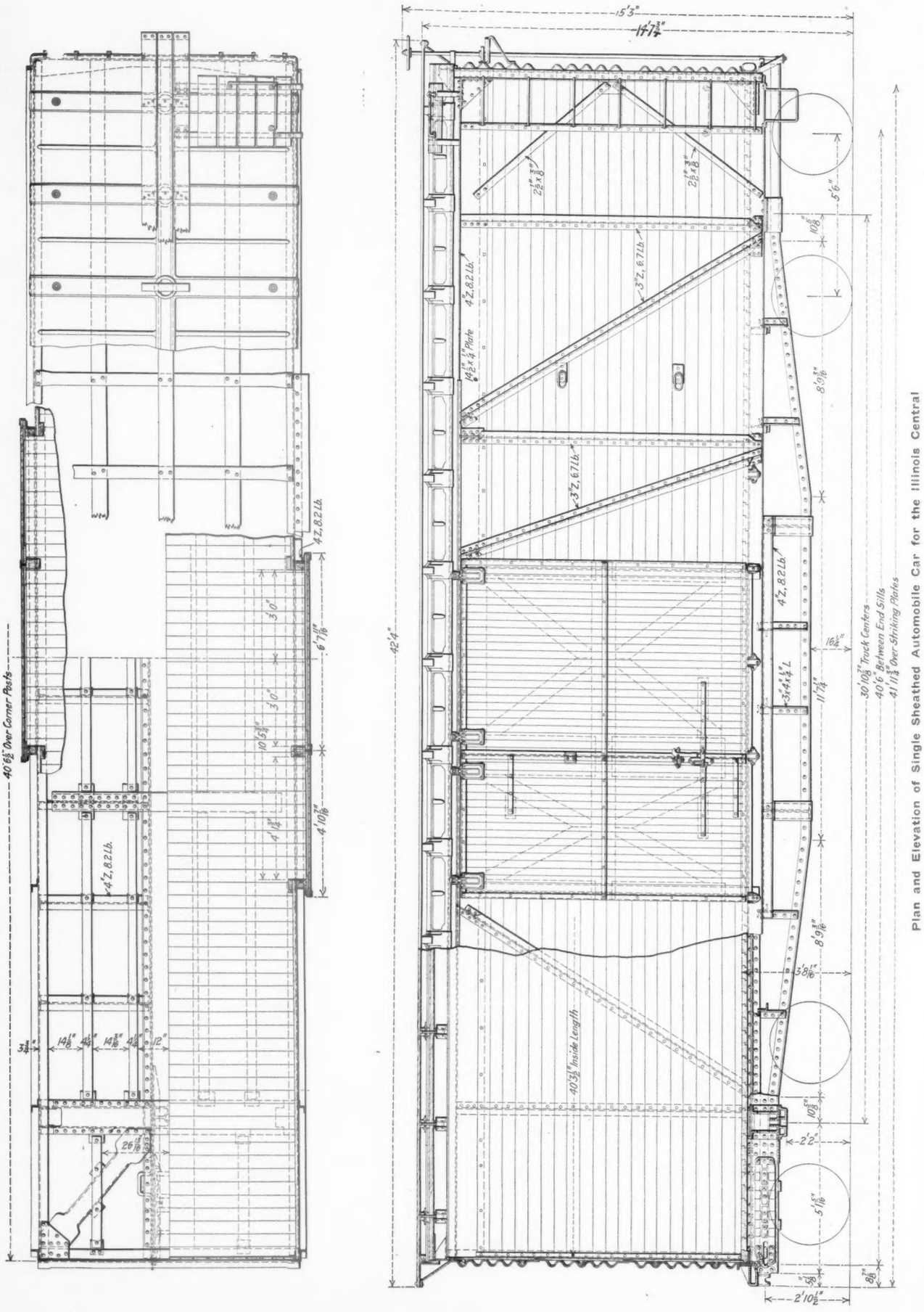
Single Sheathed Type of 80,000 lb. Capacity; Designed Particularly for Carrying Various Kinds of Lading

PERSISTENT efforts have been made by many roads during the past few years to secure freight cars which are adapted for many kinds of lading. This policy, if consistently followed out, would undoubtedly bring about a reduction in the empty car mileage and an increase in the average carload. The growing tendency to design cars built for a special traffic, so that they are adapted for various kinds of lading is well exemplified by an order of five hundred 40-ft. automobile-furniture cars of 80,000 lb. capacity recently delivered to the Illinois Central by the Standard Steel Car Company. While designed primarily for automobile and furniture loading, these cars are suitable for almost any commodity that is handled in box cars, excepting grain.

Illinois Central Single Sheathed Automobile Car

These cars have a light weight of 48,000 lb. They are 40 ft. 3½ in. long and 8 ft. 6⅛ in. wide inside. The height from the floor to the under side of the carlines at the side is 10 ft. ¼ in. The cubical capacity of the car is 3,435 cu. ft. The length over the corner post is 40 ft. 6½ in. and over the striking plates 41 ft. 11¾ in. The width at the ends is 8 ft. 9⅝ in., and between the steel side door posts 10 ft. 5¾ in. The extreme height to the top of the brake mast is 15 ft., 3 in., and to the top of the running board 14 ft. 8 1/16 in. The top of the floor is 3 ft. 8 1/16 in. above the rail.

The underframe is of the fishbelly type. The web plates are 5/16 in. thick and 24¾ in. deep at the center, and 10 11/16 in. at the draft sill, extending continuously from end sill to end sill, being spaced 13½ in. apart. Along the bottom of each web plate is riveted a 5-in. by 4-in. by ⅝-in. angle, with the long flange horizontal. The top chord angles are 3½ in. by 3½ in. by 5/16 in., and to them is riveted a top cover plate 5/16 in. thick and 21 in. wide, extending the full length of the sills. From the inside of the end sill to a point 21 in. beyond the center line of the body bolster, the center sill web is reinforced by a plate 5/16 in. thick extending the full depth of the sill, having at the top, flanges

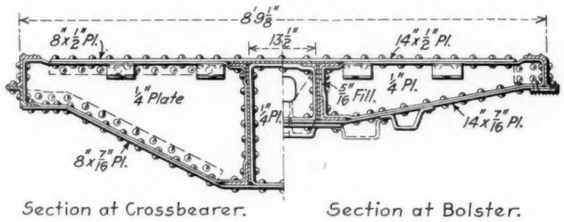


Plan and Elevation of Single Sheathed Automobile Car for the Illinois Central

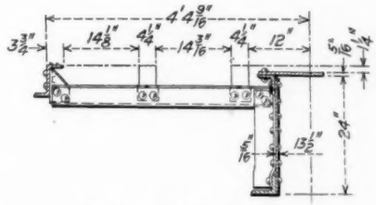
3 in. wide extending inward. These stiffeners are riveted to the inner side of the center sill web plate and to the cover plate. The web plates are also reinforced between the bolsters by vertical stiffeners of 4-in. by 3-in. by ¼-in. angles, which are spaced approximately 3 ft. 6 in. apart and serve also as supports for the floor beams. Malleable iron cheek plates of the double pocket type are riveted inside the draft sills. The couplers have a 5-in. by 7-in. shank and 8½-in. butt. A cast steel yoke having an ultimate strength of 450,000 lb. is used. It is attached to the coupler by a key and is fitted with one M. C. B. class *G* draft spring and one Harvey friction spring. The Carmer release rigging and Imperial centering attachment are used.

The body bolster is of a box section. The diaphragms are of ¼-in. pressed steel plate with 3-in. flanges all around and are spaced 8 in. back to back. At the outer end of the diaphragm there is a spacer made of a 7/16-in. bent plate. The spacers between the center sills at the bolsters are of cast steel. The top bolster cover plate is 14 in. wide and ½ in. thick extending from side to side sill. The bottom cover plate is 14 in. by 7/16 in. and extends the full width of the car. The cast steel body center plate is fastened under the bottom cover plate and is riveted through the bottom chord angles on the center sills and also to the center sill spacer casting.

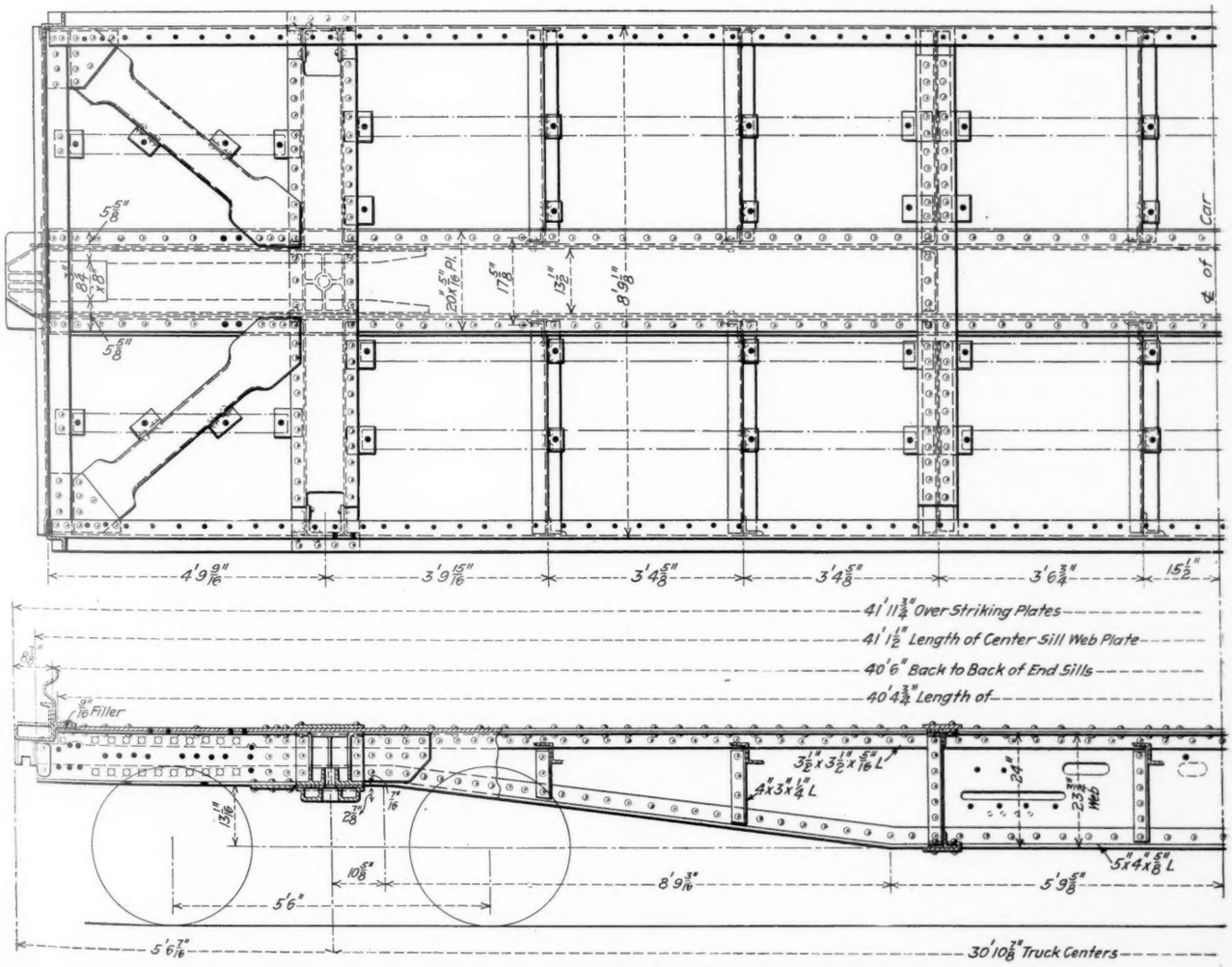
The end sills are 8-in., 18.75-lb. channels. To the back of these channels is riveted a 5-in. by 3-in. by ⅜-in. angle by which the end sill is fastened to the top of the center sill. The striking plate is a steel casting riveted to the end sill and to the webs of the center sill. There are two cross bearers on each side of the car, spaced 10 ft. apart. The diaphragms are of ¼-in. plate with a 3-in. flange all around, reinforced at top and bottom by 3-in. by 2½-in. by 5/16-in. angles. A pressed steel filler made of ¼-in. plate is fastened between the center sills at each cross bearer. The top cover plate is ½ in. thick and 8 in. wide.



Section at Crossbearer. Section at Bolster.



Section at Crosstie.

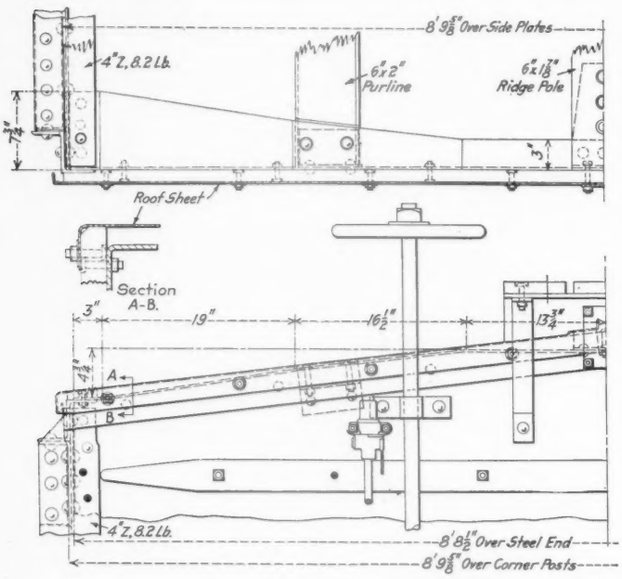


Underframe for the Illinois Central Single Sheathed Automobile Car

Plan and Elevation of Single Sheathed Automobile

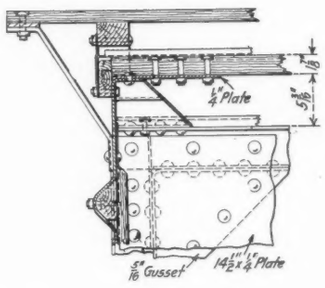
and extends out almost to the side sill, while the bottom cover plate is 7/16 in. by 8 in. and is fastened directly to the side sill.

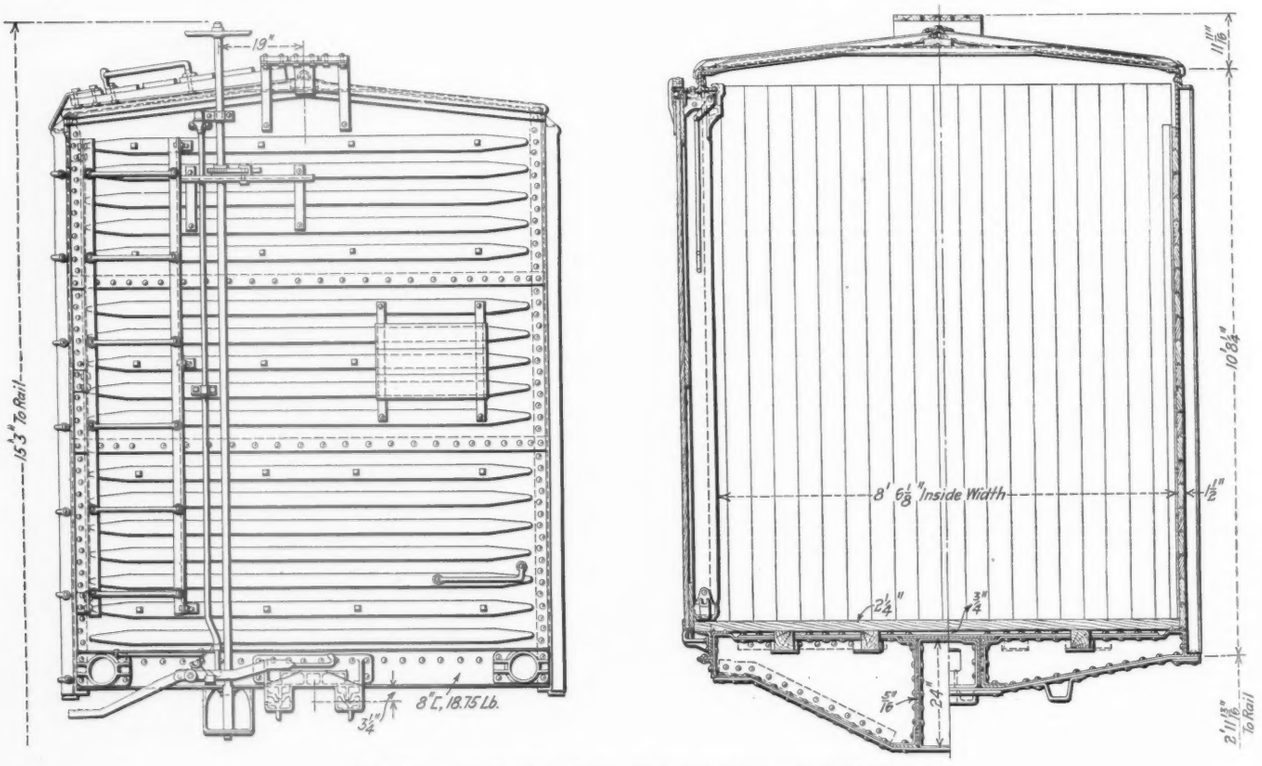
The side sills are made up of a 6-in., 16.67-lb. Z-bar of a special section incorporating a grain lock, extending from end sill to end sill. This Z-bar is reinforced under the door opening and for a short distance beyond at each end, by a 4-in., 8.2-lb. Z-bar riveted to the lower flange of the 6-in. Z-bar. The two sections thus form a channel which fits over the end of the cross bearer, the cross bearer bottom cover plate being riveted to the lower flange. The bottom cover plate of the body bolster is likewise fastened to the outwardly extending flange of the 6-in. Z-bar and a malleable iron jacketing casting is placed beneath the cover plate. The side sills and end sills are riveted together at the corners and are reinforced by a 5/16-in. plate. There are diagnonal braces extending from the corner of the underframe to the intersection of the center sill and body bolster, made up of ⅜-in. plate 12¼ in. wide, flanged in the center to a channel section. There are six floor beams on each side of the car made of 4-in. Z-bars riveted to the center sill stiffeners and to short sections of 4-in. by 3-in. angles riveted to the side sills.



Arrangement of End Plates and Roof Sheets

The corner posts are 4-in., 8.2-lb. Z-bars and the side posts and braces are 3-in., 6.7-lb. Z-bars, with the exception of the door posts, which are of the same section as the corner posts. The posts and braces are joined at the top of the 14½-in. by ¼-in. side plate girder which extends from the end post to the door posts and is riveted to the web of the 4-in. Z-bar side plate. The side plate is reinforced at the center by a 3-in. by 3 in. by 7/16-in. angle riveted to the web of the Z-bar and overlapping the side plate girder for a distance of 2 ft. at each end. The end posts are braced by 2½-in. by ⅜-in. diagonal end straps and also by flanged corner angles made from 5/16-in. plate.



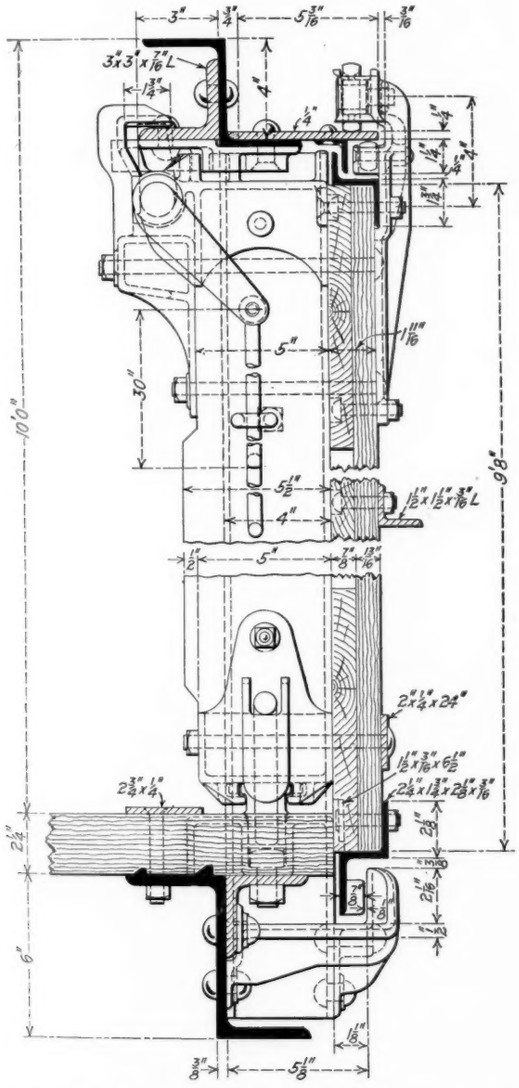


End View and Section of the Illinois Central Automobile Car

The end is of the Murphy pressed steel type, the two lower sections being of ¼-in. plate and the upper sections of 3/16-in. plate. The bottom section is flanged inward, and is riveted to the 5-in. by 3-in. angle on the inner side of

the end sill. Five transverse furring strips are provided to hold the end lining.

The floor of the car is supported on yellow pine stringers 4½ in. wide and 4 in. high. Between the body bolster and the end sill there is but one stringer on each side, but in the center of the car there are two. The stringers are continuous over the floor beams, but end at the cross bearers to which they are attached by short sections of Z-bars riveted to the upper flange. The flooring is 2¼-in. yellow pine, shiplapped, bolted to the side sills and nailed to the stringers. The siding is 1½-in. by 5¼-in. yellow pine, tongued and grooved, bolted to the posts and braces. The lower course of the siding fits over one of the ridges on the side sill, thus forming a grain lock. The siding extends to the



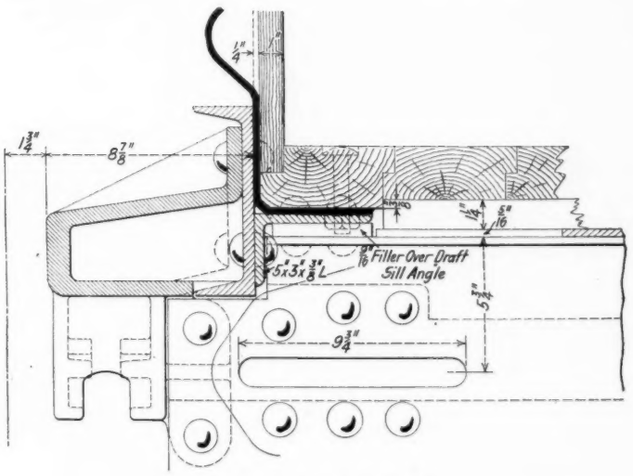
Side Door Post and Sections of Side Framing at Door

steel end sheet and an angle iron is fastened in the corner where it meets the 1-in. end lining, this angle being bolted through the side lining and the web of the corner post and also to the corner board in the end lining.

The door posts are spaced 10 ft. 5¾ in. apart, and are staggered, the distance from the center line of the car being 3 ft. and 7 ft. 5¾ in. respectively. There is a movable center door post of white oak, 4 in. by 5½ in., with top and bottom shoes of malleable iron engaging malleable housings, one on the side plate and the other in the floor. When the center post is moved over adjacent to the door post, there is a clear door opening of 10 ft. 1¾ in. When it is brought over to the point where the two doors meet it is automatically locked in position and can be bolted to the frame of the smaller door leaving an opening which is six feet wide.

The doors have steel frames made up of Z-bars at the top and bottom and angle irons at the sides with a transverse reinforcing angle across the center. The stiles, rails and braces are ⅞ in. and the sheathing is 13/16 in. thick. Camel door fixtures are used throughout.

The roof is supported on 13 carlines made of ¼-in. pressed steel plate and riveted to the top flange of the side plate Z-bar. The roof is of the all-steel type with galvanized sheets of No. 16 U. S. gage. The trucks are of the Vulcan cast steel type with cast steel truck bolsters equipped with Barber lateral rollers and a drop forged truck center plate. Brake beam safety bars made of 3-in. by 3-in.



Section Through End Sill

angles are attached to the spring plank. The air brake is the New York Air Brake Company's schedule CF-C-10 with J. M. expander ring.

SHOPPING RECORD FOR PASSENGER CARS

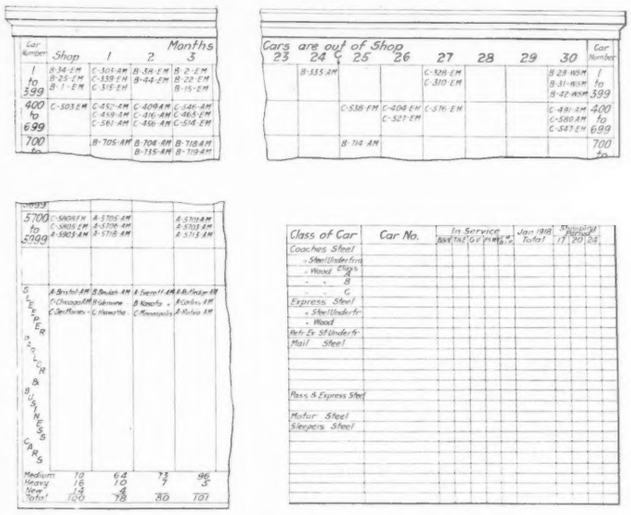
In the offices of passenger car shops it is necessary to keep records of the shopping of individual cars from which to prepare lists of equipment due for shopping. The usual form of book record is not entirely satisfactory for this purpose, as it does not make readily available the general data which are often of extreme importance. For instance, if information is desired concerning the number of cars which will be due for shopping in any particular month, it is necessary to check the records of every car unless separate statements are prepared on which this information is shown. The Chicago, Milwaukee & St. Paul has in use at its Milwaukee shops an ingenious arrangement called the passenger shopping record board, which makes it easy to compile such data and shows the condition of the equipment almost at a glance.

In order to give a clear explanation of the working of this device it is necessary to state some of the general rules governing the passenger car work. The road makes a practice of overhauling cars at regular intervals as follows: steel cars 17 months, steel underframe cars 20 months, wooden cars 24 months. The cars may receive light repairs for some special reason, but this does not affect the shopping period.

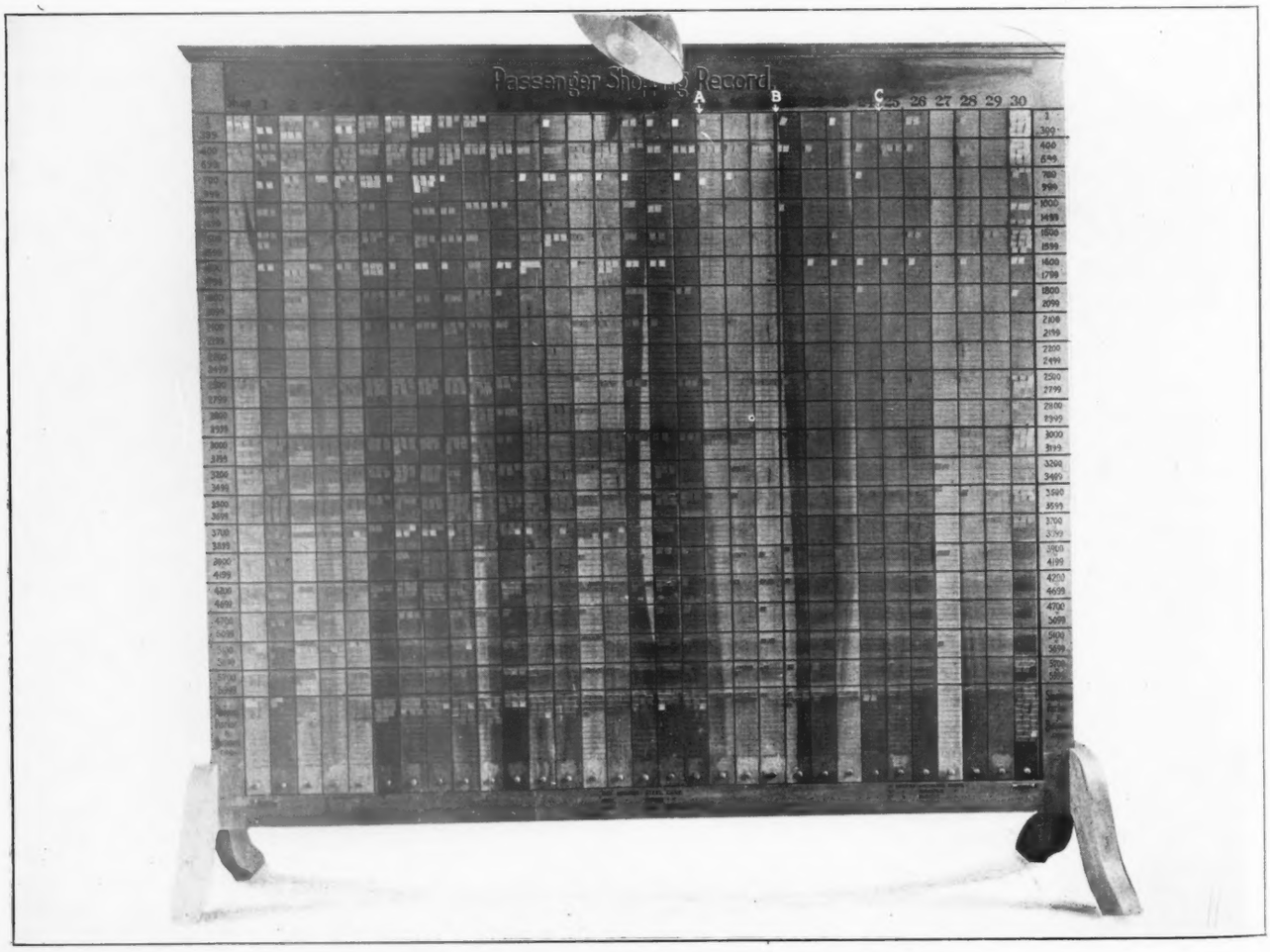
There are four shops where general repairs are made located at Milwaukee, Wis., Minneapolis, Minn., Dubuque, Iowa, and Tacoma, Wash. Repairs are classified as medium or heavy repairs and rebuilding, and some new cars are built.

The shopping record furnishes information concerning the cars and the last shopping in a convenient form. The record is kept in a frame approximately 8 feet high and 9 feet wide, this large amount of space being necessary, as the road has 1,670 passenger cars. The frame carries 31 narrow vertical panels in which are inserted small cards, each of which represents a passenger car. These panels slide in grooves along the top and bottom of the frame and those at each end are held in place by latches and can be removed if desired. The panel at the extreme left carries cards for the cars in the shops, the next has the card for all cars out of the shops one month, and so on across the board, the last panel carrying the card for all cars out of the shops 30 months or longer. The panels are divided into sections for the various series of cars, and in this way the different types as steel coaches, wooden coaches, express cars, etc., are separated. The cards, which are inserted in slots in the face of the panels, are of three different colors, red for steel cars, blue for steel underframe cars and white for wooden cars. On each card there are distinguishing marks to show the type of car (steel, steel underframe or wood), the number or name, the shop at which it was last repaired and the class of repairs it received. For example, a typical notation would be as follows: A-5718-A-M. The prefix *A* indicates that this is a steel car due for shopping at intervals of 17 months, the number shows that it is a tourist sleeper and the suffix *A-M* that it received its last shopping at Milwaukee, and was given medium repairs. If this card was shown in panel No. 7 it would indicate that the car had been repaired seven months before.

At the top of the frame between panels 17 and 18 is a letter A, indicating that steel cars beyond this point are due for shopping. It is easy to check over the red cards in



Monthly Blueprint Record of Car Repairs



Board for Keeping Record of Passenger Car Repairs

the panels to the right of the letter and determine the number of steel cars which require repairs. Similarly, the limits for the steel underframe and wooden cars are shown after 20 and 24 months, respectively. When a car comes into the shop for classified repairs, the old card is removed from the rack and a new card is made out and placed in the shop panel. At the first of each month the board is changed. Panel No. 30 is removed and placed in the shop column, moving each board one column to the right. Cars overdue for the shop and not yet brought in are replaced in panel No. 30, and cars still undergoing repairs are replaced in the shop column.

The passenger shopping record is located in the office of the general supervisor of passenger cars. While this is convenient for the main shop, it is desirable to have the same information available in the other shops, and for that reason the record as it stands at the first of each month is reproduced on a tracing, and blue prints are sent to all shops on the system. This blue print also has a list of the classes of cars, the numbers and the roads to which they are assigned. In addition it has a summary of the repairs for each month and a statement of the number of cars overdue for repairs, with comparative figures for the two preceding months. From the description given above, it is easy to see how readily the shopping record in this form can be analyzed to obtain any information desired as, for instance, the number of cars of any series overdue for the shop, the number of steel or wooden cars that will fall due for shopping in any particular month, etc. On any road having a large number of passenger cars, such a device will prove very useful.

FREIGHT CAR REPAIR STANDARDS

Government's Requirements Ambiguous; Interpretations Needed If Extravagance Is to Be Avoided

BY A MECHANICAL ENGINEER

A CLOSE study of the effort to establish "Material Standards for Freight Car Repairs," as outlined in U. S. R. A. Mechanical Department Circular No. 8 cannot but serve to convince the unprejudiced reader that it contains many ambiguities which are difficult of interpretation, that in many cases its observance is impracticable, and in other cases if followed would accomplish the introduction of the specified standards only at an expense totally unwarranted by the actual benefits realized. The introductory clause of this circular reads: "When renewing parts or applying betterments to freight cars owned by railroads under federal control, if suitable material, either new or second-hand, that is standard to the car, is in stock, it shall be used. Where such material is not in stock, material standard to United States standard cars should be used, if available."

Interpreting the above clause in strict accordance with its reading, it would appear that should parts "standard to the car" not be in stock they may not be manufactured or purchased even if readily available by manufacture or purchase, and regardless of all considerations of economy of repairs "material standard to the United States standard cars should be used, if available." Just what does "if available" mean, and to permit the observance of the most elementary principles of economy should not the conclusion of these general instructions have read, *"if readily applicable to the cars to be repaired?"*

Some of the rules set forth appear to be particularly impracticable of application and unwarranted.

Rule No. 3 reads: "Side bearings—If body or truck side bearings require changing, or renewing, frictionless type should be used, interchangeable in capacity and dimensions with those used on United States standard cars."

The committee appointed to consider the general subject of freight car repairs doubtless acted in accordance with its best judgment in deciding to extend the use of a device standardized for new cars by adopting it for repairs to cars in service. Nevertheless, it would seem that frictionless side bearings had not received a sufficiently strong majority endorsement by railroad mechanical department heads to warrant anything more than their recommended use in freight car repairs where conditions permit application without radical change in body or truck bolsters. Any one with a knowledge of the varying side bearing conditions obtaining on the multiplicity of freight car designs in service today can appreciate the problem involved in replacing the ordinary rub side bearings with the frictionless type interchangeable in dimensions with those used on United States standard cars. In many cases such replacement could not be effected for lack of space between the bolsters at the point of attachment of the side bearings; in other cases because the side bearings are cast integral with the bolsters.

As to the stipulated "interchangeability in capacity" with frictionless side bearings used on United States standard cars, an investigation will show that frictionless side bearings have not been and are not rated in accordance with capacity, the efforts of each individual designer being all in the direction of the development of devices whose several parts would continue to function properly and which could be maintained in working condition at minimum cost under the maximum side bearing loads generally obtaining.

Rule No. 4 reads: "Side truck frames—When necessary to renew side truck frames, cast steel U-shaped section, United States standard car type, with separable journal boxes, to be used."

The superiority of the cast steel side truck frame to the built-up arch bar type in rigidity, ultimate strength and durability no doubt justified its selection for the United States standard cars, but from the standpoint of supply available for quick repairs there are many who will question the propriety of designating the U-shaped section to the exclusion of the several T-shaped section designs that have given satisfactory service.

With respect to the specified exclusive use of the cast steel truck side frame for renewal of side frames in service: The intent and purpose of rule 4 evidently is the gradual elimination of all arch bar side frames and their replacement by the cast steel U-shaped section United States standard car type. A rigid adherence to this rule would obligate all railroads to immediately secure and carry a stock of the standard cast steel frame. Further, the wording of this rule is so indefinite that it seems necessary that supplementary instructions be issued stating the extent of failure which would constitute sufficient cause for renewal; that is, what proportion of the several members of the arch bar side frame should fail to warrant complete replacement with the cast steel side frame in preference to making easy and quick repairs by renewal of one or more of the individual parts.

The very extensively used M. C. B. arch bar side frame, being a built-up structure composed of solid rectangular

bars, columns and column bolts, is very seldom subject to failure in its entirety, and as all of its component parts have been M. C. B. standards for many years and as such are carried in stock by all railroads, this type of side frame lends itself to quick and economical repairs.

The quite extensive adoption and use in recent years of cast steel side frames of the pedestal type, requiring a design of journal box differing from the strictly M. C. B. standard type, presents an obstacle to the use of the standard side frame required by rule No. 4 in making renewals that could be overcome only by entire disregard of all consideration of economical repairs. It can be readily seen that in replacing a failed side frame of this pedestal type with the United States standard car type it would necessitate scrapping the journal boxes or assigning them to storeroom stock for a possible future need which might never develop.

Rule No. 6 reads: "Draft gears—(a) Friction draft gears, either Cardwell, Miner, Murray, Sessions Type 'K' Westinghouse, or similar gears, to be of not less than 150,000 pounds capacity with a maximum travel of 2¾ in.

"(b) Spring draft gears, if used, to be at least equal in capacity to two M. C. B. Class 'G' springs, interchangeable with friction gear without change in car construction.

"(c) Clearance between coupler horn and striking casting to be 3 in.

"(d) Coupler to be key connected to draft gear."

Clause (b) of rule 6 seemingly permits the use of spring draft gears of a minimum capacity of 60,000 lb., but the qualifying stipulation reading "interchangeable with friction gear without change in car construction" effectually nullifies this seeming concession, as the most casual investigation will show that no known modern arrangement of draft castings suitable for tandem or twin M. C. B. class "G" springs can be designed so as to likewise provide for friction draft gears.

This qualification being present in rule No. 6, the use of friction draft gears becomes obligatory on steel reinforcements (either draft arms or through center construction) applied to wood underframe cars, or in the replacement of spring draft gears on steel cars where suitable draft attachments standard to the car are not in stock.

The difficulties and expense incident to replacing spring draft gears, either tandem or twin, on the many steel cars so equipped, by friction draft gears are too obvious to dwell upon, and if investigated would convince operating officials of the entire impracticability of this clause of rule No. 6 and the enormous expense entailed.

Metallic draft arms in the past ten years have been found a very satisfactory, adequate and economical means of reinforcing wood underframe cars, but under rule No. 6 such draft arms must now be used in conjunction with friction draft gears. This brings about the concentration of the entire buffing shock on the center line of draft, with a resultant moment of force about the neutral axis of the section of draft arms above the bolster (which is limited by the design of the car) of such magnitude that stresses will be set up in the metal that are in excess of its elastic limit. This condition does not obtain with a 60,000-lb. capacity spring draft gear and a 2-in. coupler horn clearance, because the buffing shock delivered on the center line of draft is limited to the spring capacity, after which, with the coupler horn in contact with the striking plate the eccentricity of shock is very materially reduced. In other words, in using spring draft gears with metallic draft arms and two-inch coupler horn clearance it is possible to keep within the M. C. B. maximum ratio of unit stress to end load of .15, while in many cases it is not possible to meet this requirement with friction draft gears. Are we to eliminate an altogether satisfactory and economical method of reinforcing wood underframe cars which, when used in conjunction with spring draft gears can be designed to meet a very essential M. C. B. requirement, but which in many cases cannot be so designed when combined with a friction draft gear in an underhung draft rigging?

The foregoing is predicated in the case of spring draft gears on a clearance of two inches between the coupler horn and striking casting. Clause (c) specifies a three-inch coupler horn clearance, but when and how this is to be obtained is left to the ingenuity of the railroad making repairs. On many existing designs of underframes its reduction to practice would result in overstressing the center or draft sills between end sill and bolster.

The statement is ventured that in the opinion of many mechanical department heads spring draft gears are entirely satisfactory on any design of adequate steel reinforcement for wood underframe cars and that the greatly increased cost of applying friction draft gears to equipment of limited life and value is not justified.

Rule No. 8 reads: "Doors—Side doors on box or stock cars (except double deck stock cars) will be bottom supported and the attachments uniform with those on United States standard cars."

While there may be but few railroad men who will question the superiority of the bottom hung side door to the top hung door, it is difficult to understand the viewpoint of the committee on car repairs in making the bottom hung door an absolute requirement for repairs. In many cases this would necessitate extensive alterations at the side plate and side sill, and possibly involve rebuilding the doors themselves at a cost many times greater than that involved in merely replacing all the original door fixtures.

Rule No. 9 reads: "Ends—Box cars with weak constructed ends requiring two-thirds of end to be renewed should be reconstructed as follows:

"(a) Horizontal corrugated steel ends (two or three-piece) having top section three-sixteenth inch thick, and bottom section or sections one-fourth inch thick and corrugations 2½ in. deep.

"(b) Vertical reinforced ends with 4 or 5 in. 'Z' bars securely fastened to place on end sills and end plates. End plates to be diagonally braced on inside of car, under roof, to side plates, or with reinforcements equivalent in strength."

While a certain latitude is permitted in renewing weak constructed ends because of the two different methods stipulated, an analysis of clause (a) of this rule discloses the fact that it becomes necessary to use one proprietary structure, notwithstanding the fact that the U. S. R. A. specifications for new cars permit the alternate use of three different types of steel ends. To those railroads to whose cars another design of steel end might be more economically applied the injustice of this very narrow restriction is most apparent.

Rule No. 12 reads: "Roofs—When roofs are changed or renewed, outside flexible type metal roof made of 22 or 24 gage galvanized iron with mullions between roof sheets and with flexibility at eaves and ridges, will be applied. Roofs should be interchangeable with United States standard cars having same length and width sheets. To permit the use of standard sheets, the following changes may be made:

"(a) Increase or decrease in thickness, or omitting eave molding, fascia, or both.

"(b) Increase the width of roof flashing at eaves.

"(c) Where cars are equipped with all metal roofs, such construction may be continued when renewals are necessary, if considered desirable."

The effect of this rule on freight car repairs and its practical application is largely a question of interpretation. Taken by itself its observance is required only "when roofs are changed or renewed," but when linked up, with the introductory clause of the circular, it apparently becomes necessary to remove without regard to expense a partly worn-out all-wood or inside metal roof.

There are many who endorse the benefits and economy to be derived from standardized freight cars and locomotives building and hereafter built, while there are also many who oppose such rigid standardization as has been adopted for United States standard cars, but those who advocate standardized new equipment could not pursue a plan better calculated to discredit their views than by acquiescence in the enforcement of Mechanical Department Circular No. 8. If held to be mandatory and put into execution, it would add such a burden of increased cost of freight car maintenance as to rival the increase in direct labor operating costs already imposed by government control. It is an abortive attempt to extend standards never originally contemplated for anything but new cars of one general predetermined design to some two million (2,000,000) cars of a multiplicity of designs now in service without regard to the enormous cost involved, and it would seem that the Railroad Administration in approving it had acted with a very indefinite knowledge of what its actual reduction to practice would mean.

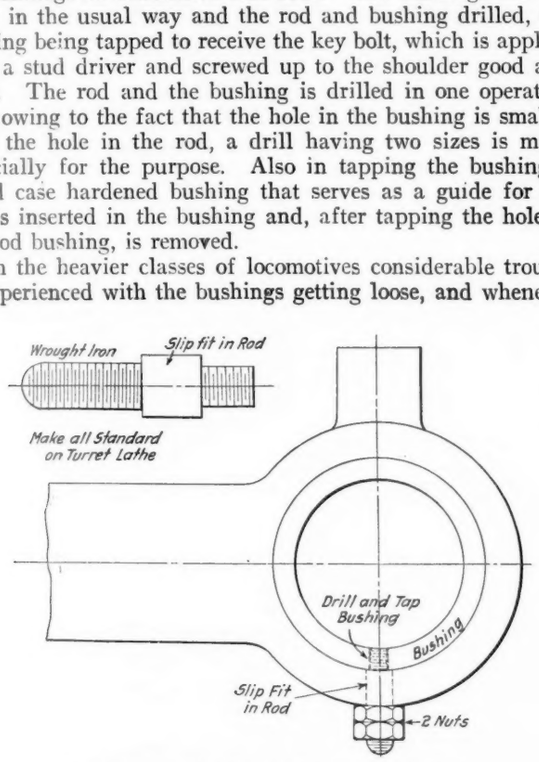
SHOP PRACTICE

AN IMPROVED KEY BOLT FOR PARALLEL RODS

BY J. H. HAHN
Assistant Roundhouse Foreman, Norfolk & Western, Bluefield, W. Va.

The illustration shows an improved key bolt for securing the bushings in locomotive side rods. The bushings are applied in the usual way and the rod and bushing drilled, the bushing being tapped to receive the key bolt, which is applied with a stud driver and screwed up to the shoulder good and tight. The rod and the bushing is drilled in one operation and, owing to the fact that the hole in the bushing is smaller than the hole in the rod, a drill having two sizes is made especially for the purpose. Also in tapping the bushing a small case hardened bushing that serves as a guide for the tap is inserted in the bushing and, after tapping the hole in the rod bushing, is removed.

On the heavier classes of locomotives considerable trouble is experienced with the bushings getting loose, and whenever



Key Bolt for Holding Bushings in Side Rods

this happens it becomes necessary to remove the rods and shim the bushings, and when a middle connection side rod has to be removed for loose bushings it means quite an item for labor and time the engine is out of service. This rod key bolt was designed to eliminate a great deal of this trouble. If, when this key bolt is used, the bushing gets loose in the rod it can be held firmly in place by tightening the inside nut shown on the stud and locking it with the lock nut. As an additional precaution a cotter can be applied to the end of the stud. This will securely hold the bushing and permit additional mileage. As a matter of fact this can be repeated until the bushing becomes too large for the pin when, of course, it will become necessary to apply a new bushing.

The writer has applied quite a number of these key bolts and has always found them satisfactory. The key bolts can be made on a turret lathe and carried in stock ready for use.

RAILWAY WOMEN EMPLOYEES

The annual report of Director General McAdoo to the President contains a summary of the number of women employed and the character of the work for the dates of January 1, April 1, July 1, and October 1, 1918. The total number of all classes of employment has increased as follows: 60,555 on January 1, 65,854 on April 1, 82,370 on July 1, and 101,296 on October 1. The occupations served by the women are divided into 21 classes, which are shown in the following table, with the number of employees in each class on October 1, 1918:

Attendants	2,390
Bridge tenders	12
Car department	684
Clerical or semi-clerical	73,285
Cleaning	5,555
Elevator operators	97
Messenger service	736
Personal service	2,796
Roundhouse work	1,365
Shopwork	5,091
Signal service	220
Station agents, assistants and agent operators	377
Supervisors of women employees	113
Switch tenders and other yard work	50
Telegraph operators	2,396
Telephone operators (train orders, blocking and reporting trains)	2,613
Track work	872
Train service	100
Warehouse and docks	1,461
Watch women	518
Other service	565
Total	101,296

It will be seen from the above that the largest group is included under "clerical or semi-clerical," in which there are 73,285, or about 72 per cent of the total number. Of the remainder, 11,864, or 11.7 per cent, were employed chiefly in mechanical department work, being divided as follows:

Car department:	
Coach and car carpenters, helpers and apprentices	65
Coach and equipment painters	52
Coach and car repairers	46
Pattern makers, helpers and apprentices	3
Upholsterers and seamstresses	124
Other car work	394
Total	684
Cleaning:	
Car cleaners	3,704
Stations and offices	1,286
Shops	284
Other cleaners	281
Total	5,555
Messenger service:	
Day work	727
Night work	9
Total	736
Roundhouse work:	
Calling crews	66
Cleaning headlights and lanterns	20
Roundhouse clerks	204
Supplying engines	27
Wiping engines	1,000
Turntable operators	48
Total	1,365
Shopwork:	
Blacksmiths, helpers and apprentices	35
Boilermakers, helpers and apprentices	6
Coppersmiths, sheet-metal workers, pipe fitters, helpers and apprentices	14
Electricians, helpers and apprentices	36
Laborers (inside work)	3,316
Laborers (outside work)	1,314
Machinists, helpers and apprentices	370
Total	5,091

While the total number of women employees increased from 60,555 on January 1 to 101,296 on October 1, an increase of 67 per cent, the number employed in the classes pertaining particularly to the mechanical department, as above mentioned, increased from 5,978 on January 1 to 11,864 on October 1, or an increase of 98½ per cent.

INTERESTING SHOP DEVICES AT TRANSCONA

BY S. LEWIS
General Foreman Blacksmith, Canadian Government Railways, Transcona, Man.

No department of a modern shop engaged in either manufacturing or repair work has any greater effect on the output of the plant than the tool department. The Canadian Government shop at Transcona, Man., appreciates this fact, and is well equipped with modern tools and jigs for facilitating work and for reducing the cost of production. Every encouragement is given the men by the management to devise special devices for doing their work easier and in a shorter space of time. The following is a description of three devices that have given particularly good results.

JIG FOR MAKING GREASE PLUG NUTS

Fig. 2 shows a simple and effective jig for boring, facing and tapping nuts for grease plugs, which was designed by J. Darlington, foreman of the machine shop at this point. This device, which is attached to an ordinary drill, has two

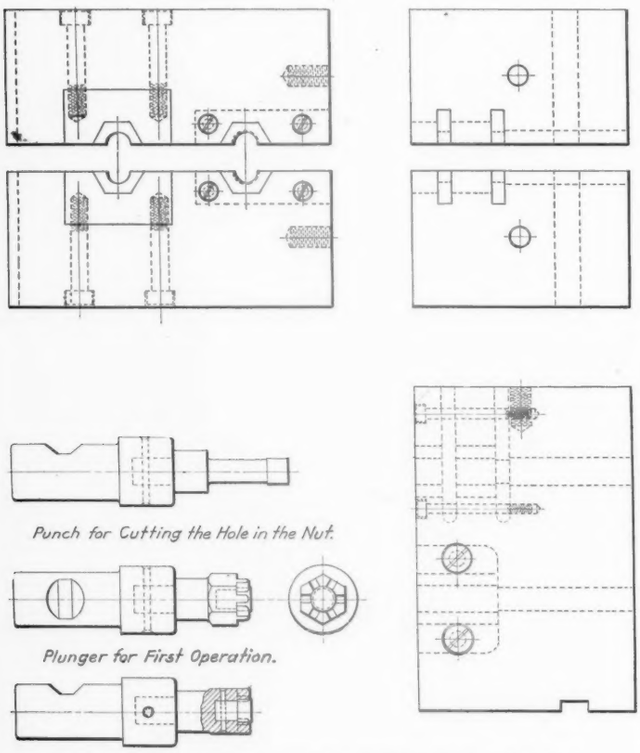


Fig. 1—Dies and Plungers for Making Castellated Nut

sliding V-blocks on top, which hold the hexagonal nut during the operation. These blocks are operated by adjusting screws as indicated in the illustration, which enable tne operator to locate the nut directly over the center of the hole in the jig.

In the base of the jig there is a brass bushing which acts as a steady rest for the boring bar, in which are located two cutters, the lower one boring the nut and the upper one facing it. Both operations are performed with one setting.

An ordinary tap, arranged as indicated in Fig. 2, is used for tapping the nut. The square head of the tap fits into

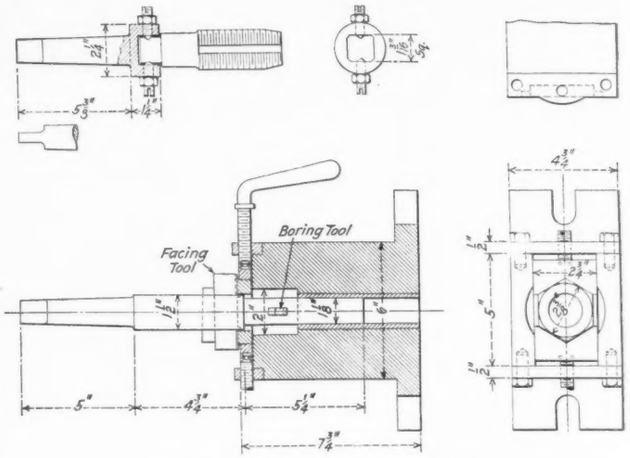


Fig. 2—Jig for Finishing Hex-Nuts

a socket and is held in place by two screws, having lock nuts, which are located on opposite sides of the socket.

Previously this work was done on a lathe, and it took from

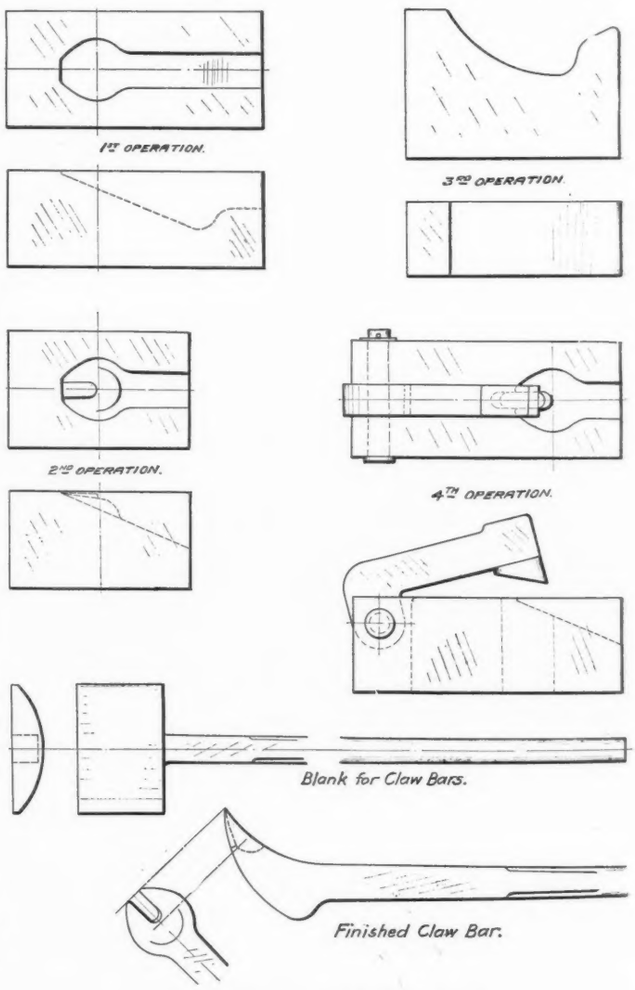


Fig. 3—Dies for Making Claw Bars

14 to 15 minutes to properly finish it, but with this jig on an ordinary drill this nut can be finished in 3½ minutes.

DIES FOR MAKING CASTLE NUTS

A set of dies and plungers used on a 2½-in. Ajax forging machine for making 1-in. castle nuts is shown in Fig. 1. With this equipment these nuts can be produced in one heat with three blows and without wasting the stock. The dies are made in two pieces to facilitate machining operations, and so that the working parts may be renewed without difficulty. The body of the dies is of mild steel, and is made from scrapped axles, while the working parts are made of Peerless *A* steel, which is hardened in air.

The first operation is performed by the plunger, two views of which are shown at the bottom of Fig. 1. It upsets and forms the castellated grooves in the head of the nut. It is of simple construction, being made in three parts, so that the wearing parts may be easily renewed. The body is made of mild steel and the other parts of 60-point carbon steel. The outside of the plunger is provided with six wings on the outside and has an inserted member for forming the inside of the nut. The punch for cutting the hole is shown above the forming plunger. Its functions are to complete punching the hole in the nut and at the same time sever the bar from the nut. It is made in two parts, the body being mild steel and the punch 60-point carbon steel. The diameter of the bar stock used for making the nuts must not exceed the root diameter of the thread in the finished nut.

CLAW BAR DIES

Fig. 3 shows a set of dies used under the steam hammer for making claw bars. These were designed by George Weston, blacksmith at this point. Four sets of dies are required for this work. The first operation gives the necessary deflection to the prepared blank. The second operation more completely forms the nose of the tool. The third operation definitely shapes the head of the bar, and the fourth operation completes it. The claw bars are made from scrap tire steel and weigh about 28 lb. The dies are simple and produce a very satisfactory bar at small expense.

SPOT WELDING RAILROAD TINWARE

Illinois Central Finds Process Applicable on Wide Range of Work; Cost Materially Reduced

A LARGE proportion of the sheet metal work used on railroads is subjected to rough usage and for that reason it must be strong if it is to give satisfactory service. In order to secure the required strength, the joints in many cases must be riveted. Riveting is slow and therefore an expensive operation, especially when the rivets must be soldered to prevent leakage. The process of spot welding has been applied to the manufacturing of sheet metal ware during the past few years with great success. As the simplicity of the process and the great strength of the joints seemed to make it well adapted for railroad work the Illinois Central about a year ago investigated the possible savings that could be effected and purchased a 10 kw. automatic welding machine, manufactured by the Automatic Electric Welding Machine Company, New York.

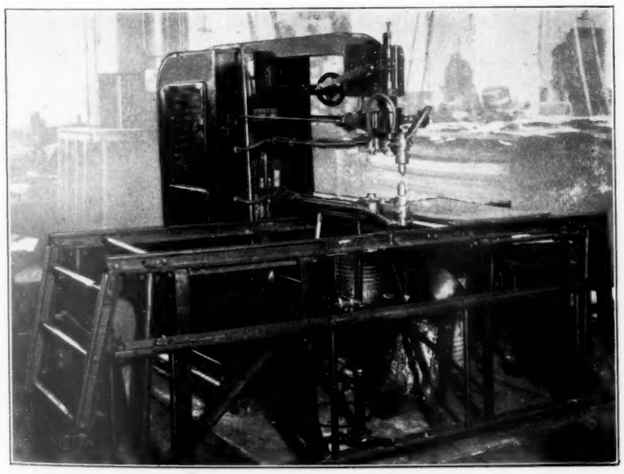


Fig. 1—Automatic Spot Welder of 10 kw. Capacity Used at Burnside Shops

A general view of this machine is shown in Fig. 1. It consists of a case containing the electrical mechanism with two arms extending from the front to which the electrodes are attached. The lower arm can be moved vertically by a screw engaging a crosshead at the front of the frame. The upper arm is stationary, but the electrode is mounted on the end of a bell crank operated through a horizontal rod from a cam in the body of the machine. This machine has a three speed transmission driven by a ½-hp. 220-volt A. C. motor. A hand wheel at the left of the upper electrode varies the speed to give one revolution in one, two or four seconds. On the cam shaft is a magnetic clutch operated by a pedal switch on a flexible cable. If the operator presses his foot on the switch once, the machine makes one weld, but if he holds his foot on the switch one weld will follow another at regular intervals, depending on the speed for which the machine is set.

The cam action is transmitted to the bell crank through a lever and then through a horizontal pressure rod. The lever has an adjustable fulcrum providing a lift of ¼ in. to 1½ in. for the upper electrode. The pressure of the electrode on the work is changed by a hand wheel which varies the stress on the spring in the pressure rod to the bell crank. The electrodes are cooled by a continuous flow of water. The points have a Morse taper fit and are adjustable for various types of work.

The time during which the current flows is regulated by a hand wheel on the right side directly opposite the speed control. The time can be varied by small increments from zero to two seconds which makes it possible to weld from the thinnest stock up to ⅜ in. on this machine. The capacity is dependent on three factors, the amperage of the transformer, the current between the electrodes and the length of time the welding current flows, all of which are automatically controlled in the machine, after the original adjustment has been made. The machine when once set for the gage of stock involved is automatic in its action. The amperage, pressure and time are adjusted by a foreman or electrician thoroughly familiar with the work of electric spot welding, after which any operator capable of feeding the work can secure perfect welds. The automatic features of the machine are important in reducing the cost of labor and in eliminating the waste due to burning or imperfect welds resulting from poor judgment on the part of the operator.

The machine installed at Burnside has proved well adapted for work on railroad tinware. It welds bright tin and black

sheet iron very readily. The parts must be flat so that a good contact will be made between the contact points and the surfaces must be free from rust. Galvanized sheets are more difficult to weld satisfactorily, but by using a slow speed and a comparatively low current with small contact points the zinc coatings can be pierced and a good junction secured. In making ventilator screens it has been found quite feasible to weld brass screens to the galvanized frame.

Table I—Savings Effected by Welding Kettle Ears

Fastening Kettle Ears by Riveting	
Punching	$0.68
Riveting	1.53
Soldering over rivets	.68
Total labor	$2.89
Rivets	.50
Solder	.30
Total labor and material	$3.79
Number of ears riveted	576
Fastening Kettle Ears by Welding	
Labor	$1.20
Number of ears welded	576

The savings effected by welding can best be illustrated by citing a few examples of typical jobs. In fastening kettle ears on buckets, the former method was to rivet them on, covering the heads with solder. Spot welding is much quicker and the cost is only 32 per cent of the cost of the riveting. A detailed statement of the cost of doing this work is given in Table I.

Table II—Welding Compared with Other Tin Shop Methods

Name of part	Cost by former methods: Labor	Material	Total	Number made	Cost of welding	Number welded
Lamp chimney baskets	....	....	$10.56	100	$3.52	100
Sheet iron lamp shades	....	....	1.57	500	.85	500
Switch lamp lens bands	$20.00	$1.50	21.50	3,000	12.21	3,000
Stove pipe elbows	....	....	14.40	250	7.20	250
Ventilator screens	6.43	1.31	7.74	450	2.38	450
Split keys	52.00	10.00	62.00	20,000	30.32	20,000

Another typical operation to which spot welding has been applied is making the tops for water glass lamps. These were formerly soldered at a cost of $3.40 per thousand for labor and $.40 for material. The same quantity can be welded at a cost of $.85 for labor. On this job there is an additional saving in the material from which the parts are made. When solder was used it was necessary to make the tops of tin, but sheet iron can now be used. The cost of other typical parts are tabulated in Table II.

The manufacture of flat split keys is one of the principal jobs handled on the spot welder. To expedite the work a special attachment shown in Fig. 2 has been devised. The framework holds a stationary disc, the edge of which is set between the welding points. Above this disc is a movable disc with recesses around the edge, of the same size and shape as the end of the cotter. Above each of the recesses is a spring which holds the parts when they are placed in the slots. At each revolution of the cam shaft the disc is advanced the distance between the slots by a ratchet operated by an electrically controlled valve, thus bringing the two pieces making up the key into position between the electrodes. A contact is then made and the parts are welded after which the ratchet advances them one notch further. The welded cotter then passes over an opening in the stationary disc where a finger on a rod attached to a lever on

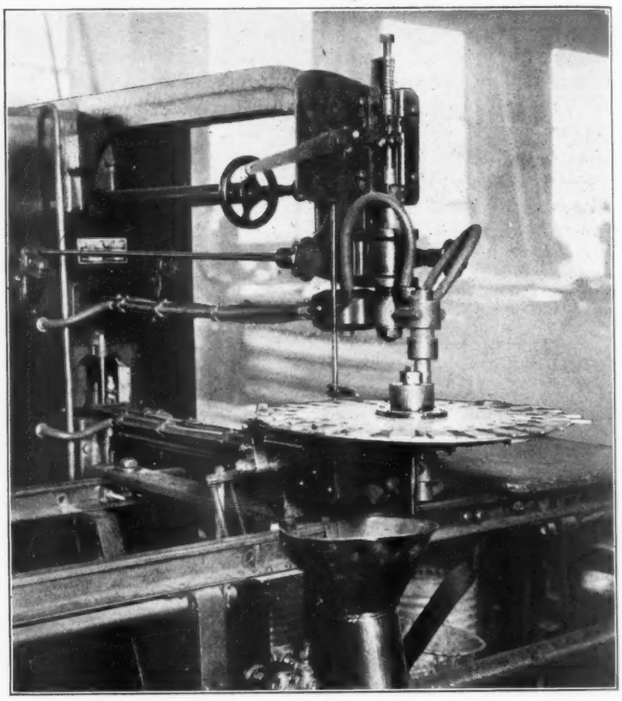


Fig. 2—Attachment for Welding Split Keys

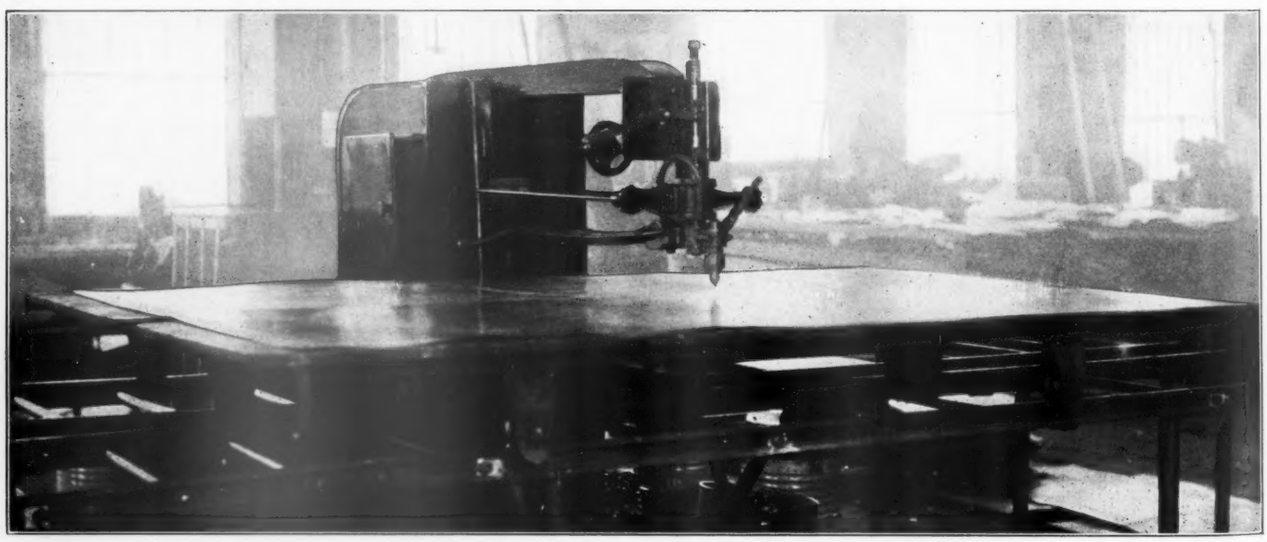


Fig. 3—Machine Arranged for Spot Welding Locomotive Jackets

the upper arm of the machine strikes it, causing it to drop into the receptacle beneath. The parts can be welded as fast as the operator can feed them. As many as 5,000 cotters have been made in seven hours.

Another important job for which special attachments have been made is the welding of locomotive jackets. The large sheets are placed on rolling tables as shown in Fig. 3 and are simply lapped and welded together along the edge at intervals of about ¾ in. to 1 in. The description of some of the typical parts made by spot welding as given above will serve to show the adaptability of this machine. Further developments are to be expected and devices of this type will probably become important adjuncts to railroad tinshops.

WHEN THE SEWING CIRCLE FAILED TO MAKE GOOD

BY HARVEY DE WITT WOLCOMB

Jim Haskins, the general foreman of the big shops of the Northwestern Railroad at Warren, was puzzled. Not alone puzzled, but disgusted also. He had just returned from his daily morning conference with the "Old Man," at which certain shop matters had been discussed and orders issued which Jim knew were contrary to the general policy of the shop. Heretofore the "Old Man" had always claimed that he did not care what the men or foremen did outside of shop hours; but this morning he had said that if big Bill Munson, the foreman of the boiler shop, did not cut out neglecting his family he would soon be looking for a new job. Bill Munson was a particularly good foreman, always on the job, a good mechanic himself and able to handle men. He actually obtained more work from two men than it was formerly possible to get from four men.

While Jim Haskins, as general foreman, worked with Bill practically every day in the week, he had never taken the trouble to look into his private family affairs and as long as the boiler shop was handled so efficiently, there was no need to investigate the man's home. Subconsciously, Jim Haskins felt that some one was trying to run Bill Munson off the job. By several remarks which the "Old Man" had made lately he knew there was a storm brewing. But why? Personally, he couldn't see one reason why Bill Munson wasn't the most valuable foreman they had. He had told the "Old Man" so, but he wouldn't have it that way. Jim had even quoted facts and figures to prove how much better Munson was than his predecessor, but to no avail. The "Old Man" had brought up little occurrences which Jim Haskins could remember when they were mentioned, but which had had no great weight on the management of the shop.

But now the "Old Man" was quoting these little things and placing so much emphasis on them that things actually looked bad for the boiler foreman. After Jim had left the office the thought suddenly struck him—where had the "Old Man" heard this stuff? Surely Munson had not said anything about his family affairs—Jim himself had not said anything about it—so where was the leak? To take such dirty, low-down, underhand methods to run a man off the job made Jim Haskins mad. He was a fair and just man himself. That was why he was so popular with all the shop men and was so successful as a shop manager. And he could not for the life of him understand why the "Old Man" would countenance any such doings.

Starting the day under these circumstances made Jim so disgruntled that he was on the war path all day. Try as he might, he could not get anything on the boiler department. Joe Kelly, the machine shop foreman, who Jim secretly knew was a wonderful man in the "Old Man's" estimation, but who was actually the poorest foreman he had, spoiled a driving axle, bored a set of driving boxes for the wrong wheels, nearly spoiled a new set of frames and was so careless that, driven to exasperation, Jim had to tell him frankly that if the machine department did not show a decided improvement it would soon have a new foreman. Under the conditions that morning I am not sure of all that Jim told the machine shop foreman, but he was in no mood to talk softly or mince his words, so you can wager that what he did say was forceful and to the point.

During the day many things came up which nearly drove Jim crazy, but he managed to pull through and was glad to go home where he could light his pipe and read his paper in peace.

As his wife was clearing off the supper dishes she remarked that the Munsons might move out of town. Being absorbed in his paper, Jim paid but slight attention to her remark and passed it by unnoticed. After finishing her work his wife brought out her mending and when Jim was refilling his pipe she remarked that Joe Kelly, the machine shop foreman, was talking about buying a home. Continuing she said: "Joe is a valuable man to the company and is sure of promotion and that is the only reason why he hesitates to purchase a home. He might just get nicely located and the company would move him to a better position."

"Yes, move him, but not to a better position if he don't mend his careless methods," grunted Jim. His wife noted that Jim was in no mood to talk, so the balance of the evening he was permitted to read his paper with no further interruptions.

The next morning as Jim started for the "Old Man's" office, he wondered what would be discussed. Engine failures were being held down to the minimum and the output was good. As he had had a good night's rest and the shop affairs were moving smoothly, Jim felt good natured. He even felt inclined to go in the boss's office, slap him on the shoulder and say, "Well, old timer, we've got them on the hip now. Everything is moving O. K."

But the minute he stuck his head inside the office door he could see trouble was brewing. The "Old Man" didn't waste any time, but started right in on Jim and bawled him out good and proper. To say that Jim Haskins was surprised is putting it mildly. He was dumbfounded! Since his appointment as general foreman at Warren he had doubled the shop output, had cut down engine failures, had reduced the pay roll, got along fine with the men and had carried on several improvements that were much to the advantage of the place, and now the "Old Man" was telling him what a poor stick he was. He told him all about his trouble with the machine shop foreman and informed him that the machine shop foreman was not responsible for such mistakes, but that he, the general foreman, was the one to blame. The "Old Man" even went so far as to say that the machine shop foreman would not be discharged, but if any such disgraceful recurrences came to his notice, the general foreman would have to do some explaining.

Can you imagine how Jim Haskins felt after a call-down like that? One day the "Old Man" wanted to discharge the best foreman on account of some trivial family affair and the next day he wouldn't allow the dismissal of a foreman who was the biggest failure in their organization. Poor Jim wondered who was stuffing the "Old Man" with all his misinformation. He tried to explain his position, but the "Old Man" would have none of it. Jim welcomed the opportunity to get out of the office when the chief clerk told him that something had just gone wrong with the turntable.

And again Jim's day was spoiled. He had started out in the morning well satisfied with conditions—in fact in fairly good humor, but the "Old Man's" talk had changed

him into a frame of mind that was far from pleasant. He did not try to take any spite out on his foreman, but just the same he felt ugly enough to bite a ten-penny nail in two. He put in a most unpleasant day and was glad to escape to his home where he could eat his supper and enjoy a quiet smoke.

Again, as on the previous night, his wife ventured a remark that Joe Kelly had decided to buy that home. Subconsciously Jim felt that his wife had said something before about Joe Kelly. The Kellys were not neighbors of theirs, yet his wife seemed to mention their name a great many times. Puffing at his pipe like one of the big Mallets pushing a train up the hill, Jim reviewed in his mind all the occurrences of the past few days at the shop. Suddenly a thought struck him with such force that he yelled at his wife so loudly he nearly scared the poor woman out of a year's growth.

"Say," he said, "where do you hear so much about Joe Kelly, anyway?"

"Why, our sewing circle met this afternoon and while I was out in another room I overheard the master mechanic's wife telling how mean they used poor Joe Kelly at the shop. She said that it was a shame to pick on a good man like him and not to pay any attention to the disgraceful actions of a man like that Bill Munson. She also said that the Kellys were going to buy their home.

"By jimanetti," thought Jim, "I've got it! I've got it! It's that bunch of old hens who are trying to do poor Bill Munson. Some woman has an axe to grind and she is playing a smooth game." With that Jim began to question his wife and from her he could piece out a pretty good story of how this woman and that woman was working through her husband to try to influence the inside workings of the busy terminal at Warren. As Jim thought over the situation and recalled many little things which had been pulled off in the shops he could see the propaganda of the busy and ever watchful ladies' sewing circle. The master mechanic's wife was a prominent member. She was just foxy enough to work on her husband so that she influenced many of the orders he issued.

After turning the entire situation over in his mind several times Jim finally decided that the best way to fight fire was with fire.

The next morning he had a long talk with Bill Munson. During their conference they had several good laughs, and while Bill at first refused to follow Jim's instructions, he finally gave in.

Well, to make a long story short, Bill Munson's wife joined the sewing circle. She became a very prominent member and worked her way into the good graces of the master mechanic's wife.

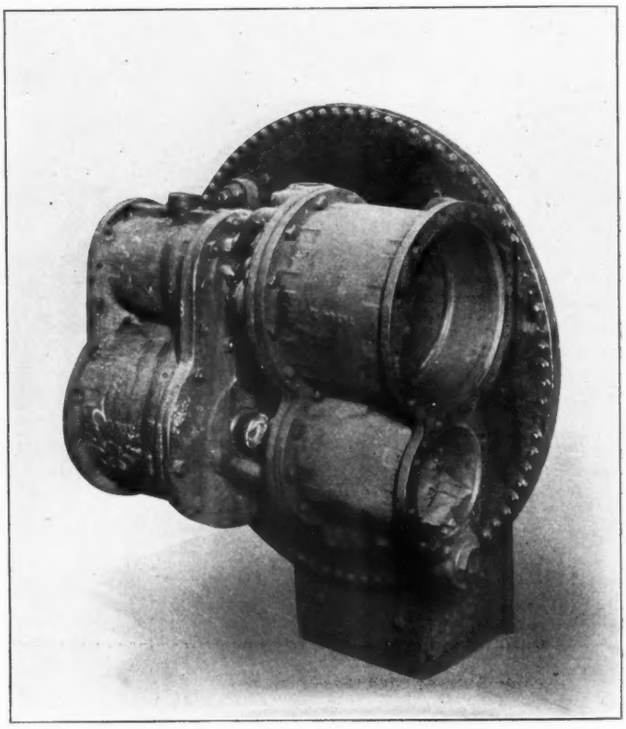
Jim Haskins noted that the complaints about the boiler department seemed fewer and fewer. About two months after Jim Haskins awoke to the fact that wives play an important part in the management of a shop. He was agreeably surprised one morning by having the master mechanic remark that the boiler department was so efficient that he had recommended an increase for the foreman, Bill Munson.

Right there Jim Haskins smiled to himself, for he knew that instead of running a good man off the job, the sewing circle had actually been the means of securing him an increase in wages.

Increase in Coal Production.—Bituminous coal production in the United States during 1918, as reported by the National Coal Association, amounted to 587,500,000 tons, an increase of approximately 36,000,000 tons, or nearly seven per cent, over the production in 1917, which was in itself a record.

A CONVENIENT STAND FOR AIR PUMPS

In overhauling air pumps it is desirable to have them mounted so that the cylinders can be placed either vertical or horizontal as desired. The stand shown in the illustration below, which has been in use for some time in the Joliet shops of the Elgin, Joliet & Eastern, makes it easy to bring the pump into any position. The stand is supported by a heavy post bolted to the floor. Near the top of this post is pivoted a disc made up of two plates riveted together to obtain the required stiffness. Behind the bottom of the disc and attached to the post are rollers which help to support the plate and make it easy to turn. There is also a cross piece attached to the post with a pin in the cross piece fitting into holes in the rear plate, thus holding it securely in any position. This stand is particularly suitable for cross compound pumps.

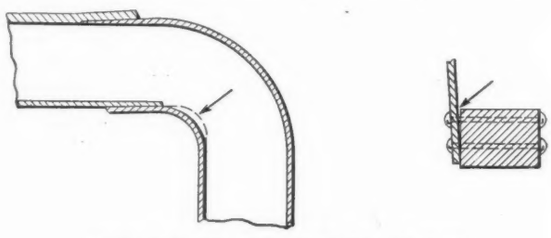


A Stand Used for Holding Air Pumps When Making Repairs

MAKING MUDRING CORNERS TIGHT

BY JOSEPH SMITH

No one knows better than the roundhouse man what a hot, dirty job is occasioned when an engine is reported with the back mudring corners leaking. Not only this, but many times it means a serious delay in engine service. By carefully noting the reasons for this condition we have come to the conclusion that 95 per cent of the troubles are due to



Imperfect Fit at the Mud-Ring Corners

the fact that, as shown in the illustration, there is a space of ¼ in. to ⅜ in. between the sheet and the top of the mudring. Cracks frequently occur in the sheet around the corners at the top row of rivets, and while welding them will help for a little while, it is finally necessary to cut out the sheet and weld a new piece in. This trouble could be eliminated if, when fitting the firebox to the mudring, the corners were well heated and set up tight before riveting.

MACHINING LOCOMOTIVE DRIVING BOXES

Time and Effort Will Be Saved by Doing Accurate Work; Special Devices and Tools That Will Assist

BY M. H. WILLIAMS

THE machining of locomotive driving boxes is quite an item in railway shops, and on account of the number that must be repaired the question of special machines and appliances for this work should receive special attention. It will often be found economical to install a special machine for these parts and use it exclusively on this work. On some machines the driving box shell may be bored, the hub liner faced and the oil cellar bored to the radius of the axles at the rate of three an hour, or 24 in an eight-hour day, an output equal to the demands of many of the larger repair shops. This will be found to be a greater output than is generally obtained on what may be called universal machines. As the driving box job has come to stay, it certainly should pay to install the very latest machine tools for the purpose of handling the work. One special machine for this work will in many cases release two machines, such as vertical or horizontal boring mills, for other work.

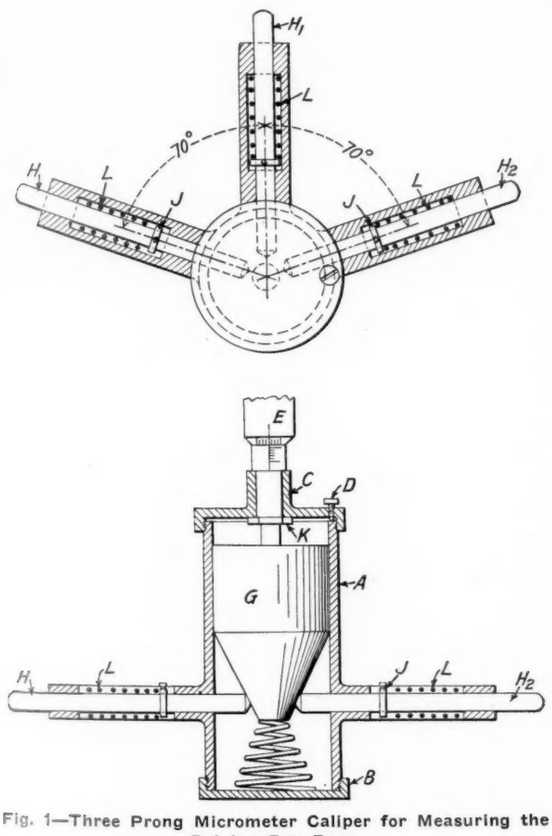


Fig. 1—Three Prong Micrometer Caliper for Measuring the Driving Box Bore

Accurate machining will also be found to be a paying proposition on these parts for the reason that when machined to proper sizes the work of assembling on the axle and locomotive will be reduced and an all-around saving will result. With a few special appliances, which will be described, the shells in the boxes may be bored, the sides faced and the cellar bored so accurately that individual fitting of the axle by filing or scraping may be entirely eliminated and better fits be obtained than with the general practice of scraping and filing. Several methods may be followed when performing this work. Those explained below have been taken from practices in several shops and will serve to illustrate various ways this work may be done.

First, it may be well to mention a few special appliances that may be used to good advantage in obtaining accuracy and reducing time.

Press for Applying Shell.—One of the first machine tools required is a press for removing and applying the shells. For this purpose the ordinary vertical hydraulic press answers very well and needs no explanation to railway shop men. In many respects it is advisable to equip this or any other form of press with a recording gage in order to produce a record of the pressure exerted when applying the shells. This, no doubt, may look like a refinement. However, a few points should be kept in mind. If the shell is forced in at too great a pressure the box will be spread apart and throw the shoe and wedge faces out of line. On the other hand, too low a pressure may result in the shells becoming loose. If a record of the pressure applied is kept it will soon be possible to determine a proper limit to be followed. The workman can also by observing the records, judge as to his work of fitting the shell and be governed accordingly when fitting future boxes. Records of this nature will be of interest to the shop manager and should be filed to be used in case of controversy. In many respects it will be found advisable to assign one press for applying shells, various side rod bearings and link motion bushings and equip it with a gage, using a second press for removing these parts. On account of the great pressure often necessary to start a shell, side rod brass or link motion bushing, a gage, if used on a press common to all work, will soon be in bad condition, due to the great pressure necessary to start a part loose.

MEASURING BORE OF SHELLS AND BOXES.

Measuring the bore of the brass or bronze shells and also the slotted half-round surface in the driver box for the shell bearing is very important, but difficult on boxes where these surfaces are less than a half circle and where the ordinary calipers cannot be used. A three-prong micrometer caliper has been used for this purpose, which answers very well, this being shown in Fig. 1. This is made up of an accurately ground steel cylinder *A*, having walls about ⅛ in. thick and the hole about 1 9/16 in. in diameter, a cap *B* at the lower end to resist the spring *S* and also to exclude dirt, and an upper cap *C* carefully threaded to fit the top of *A*. Adjustments of the caliper are made by this head and when it is

properly set it is locked by the set screw *D*. A micrometer head *E*, such as may be obtained from several makers of these instruments is secured to the cap *C* by means of a nut *K*, fitting on a thread cut on the micrometer. This micrometer head is graduated for inside measurements or in opposition to the ordinary micrometer; that is, the readings are the smallest when the barrel is backed all the way up; as the barrel is screwed down, the readings become larger. The end of the micrometer screw bears on a hardened and ground plunger *G*, which fits very accurately into case *A*. The bottom of this plunger is accurately ground to a taper of six inches in twelve inches. The spring *S* forces the plunger *G* upwards against the micrometer head and takes up lost motion. Three rods, *H*, H_1, and H_2 fit into projections that are a part of case *A*. These rods are made of steel wire about ¼ in. in diameter, and are carefully hardened and ground, all three to exactly one length. The outer ends are slightly rounded, very similar to measuring rods used with micrometer calipers, the inner ends having points agreeing with the taper of the plunger. These rods are forced toward the center by springs, *L*, bearing against the frame and collars *J*. The three projections on the case are spaced at an angle of 70 deg. The rod *H*, H_1 and H_2 are of suitable lengths for shells and boxes to be measured. For measuring from seven to eight inches these are approximately 3¼ in. long. For each larger or smaller size the length will be increased or decreased by ½ in. Several sets of these rods may be used in one case where it will be necessary to change the rods when making measurements varying over one inch and will answer for small shops. Separate cases may be made for each size, which will avoid changing the rods.

For the purpose of setting this instrument, caliper rings carefully ground on the inside to even inch sizes are used. When setting the caliper the top cap *C* is adjusted up or down until the micrometer head registers zero, with all three rods in contact with the inner surface of the setting rings. After this the screw *D* is tightened to prevent the head cap *C* from turning.

In operation the plunger *G* is controlled by the micrometer head and opposed by spring *S*. The plunger *G* in turn controls the rods *H*, H_1 and H_2. It is obvious, on account of the angle on the plunger being six inches in twelve inches, that the rods will be forced out one-half the travel of plunger *G* and as the rods measure the radius, the reading on the micrometer head will show the actual diameter. When measuring the diameter of the bore of a shell or the slotted inner surface of the driving box, the micrometer head is screwed up or down until all three rods are in contact. No difficulty is experienced in determining this. If set too large the two outside rods *H* and H_2 only will be in contact, and by giving the caliper a slight rocking motion so that middle rod H_1 rises and falls, it will be noticed that the center rod is not in contact. Or if set too small the middle and only one side rod will touch, and by giving the caliper a slight right and left hand turn a very minute space may be detected. In practice a box or shell may be measured in a few seconds and to an accuracy of the thickness of a sheet of paper. This device is very valuable for measuring the bore of shells, and also to prove the accuracy of boring mills. With the best mills there is always the possibility of the boring head not being perpendicular to the mill table, causing the shell to be bored larger at one end.

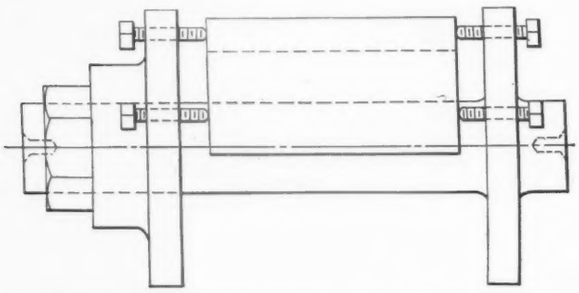


Fig. 2—Arbor for Turning Driving Box Brasses on a Lathe

Several different methods are followed for measuring the bore of boxes and shells. It is a question if any are more accurate or handy than using the three-pronged micrometer described. One of its greatest advantages is the fact that the machine operator can check his work and tell when it is correct, both for size and the straightness of boring. As the accuracy of boring is increased the labor of fitting the box to the axle will be reduced. To properly make use of this device the axle should also be measured with micrometers.

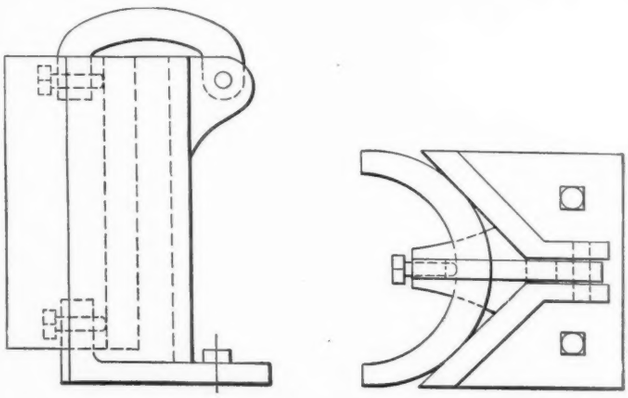


Fig. 3—Jig for Holding Driving Box Brasses When Machining the Ends on a Slotter

MACHINING SHELLS.

For machining the outside surface of the brass shells several methods are employed, one being to clamp the shells to the table of a vertical slotter and revolve the table as the surface is being finished. This method is quite satisfactory. It, however, requires a somewhat expensive machine tool, compared with other methods. Another way is to hold the shell on a revolving arbor on a shaper table. In this case the arbor is revolved by a worm gear and wheel and generally operated by hand. This method works very well and does not require as expensive a machine as the slotter. In many respects the simplest and quickest method is to turn the shell on a lathe. For this purpose an arbor, as shown in Fig. 2, answers very well. This is made up of a heavy central bar about four inches in diameter, having a collar at one end forged solid with the arbor, as shown at *A*. On this arbor a loose collar *B* is fitted fairly snug. This is also keyed to a spline way cut in the arbor. The collar *B* is backed up by a large nut *C*, this nut being necessary to compensate for varying lengths of shells and may also be used for tightening the collar *B* on to the shell. The set screws *D-D* are used for tightening and holding the shells and are preferably made with cup points. In practice the shell is placed on the arbor and the set screws *D* drawn up enough to just hold the shell. The shell is then adjusted to the proper distance from the center of the arbor by a hammer. When properly set the three set screws in each collar are tightened. The method of setting the shells may be modified by placing a liner of wood or metal between the arbor and shell. This will locate the shell at once. It, however, requires a separate liner for each pattern of shell. In some cases these arbors are made double, so that two shells may be turned at one time on a lathe having two tool posts. This method increases the output of shells very materially and

makes it possible to turn a pair of shells in less than 45 minutes, floor to floor. The diameter of the shells can generally be measured with calipers, as the castings in the rough are more than a half circle. In many respects a micrometer can be used to good advantage for this work, especially in conjunction with the three-prong caliper previously described.

For machining the ends of the shells several methods are employed, depending largely on the machine tool equipment available. One method is to hold the shells in a V-block set vertical on a slotter table, as shown in Fig. 3. This is made up of an iron casting *A*, which is bolted to the slotter table, and has a projection for a set screw *B* at the bottom and a hinged clamp *C* that may be thrown back when

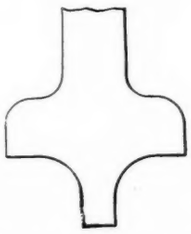


Fig. 4—A Shaper Tool for Machining the Ends of Driving Box Brasses

necessary to remove the shell. In practice the shell is placed with its machined surface against the *V* faces. The clamp *C* is brought over and the bolts *B* and *D* tightened.

Another plan is to hold these shells by means of a similar clamp on the table of a shaper, in which event the fixture and the shell are in a horizontal position. This method is applicable to the ordinary or draw-cut shaper. A slotter or shaper tool, as shown in Fig. 4, can be used to good advantage for this operation. The end of the tool is used to remove the scale on the casting, the final forming being done with the formed part of the cutting tool.

Another method is to mill these ends on a plain knee type milling machine with a cutter formed to the contour of the desired end of shell. For new locomotives, where the shells are similar, two milling cutters may be used at one time.

For the average repair work the shaper will generally be found the most desirable, and is a less expensive machine tool than the others mentioned.

REPAIRS TO DRIVING BOX SHELL SURFACE

Machining the half-round surface in the driver box into which the shell fits is not necessary where the original work has been well done and the box has not been warped or sprained in service. On account of the enormous axle pressure of heavy locomotives it is very desirable that the shell have a perfect bearing in the driving box in order that the box may properly support the shell. It is, therefore, very desirable to check the shell bearing in the boxes after the shell is removed, and should there be a great variation in the radius of this surface the box should be reslotted. Just how much variation can be allowed is an open question. However, it is desirable to err on the side of safety, and it is a question if new shells should be applied where this surface varies over 1/32 in. or .032 in. from end to end. Should the variation be greater, reslotting is advisable. This variation may readily be measured with the three-prong micrometer. The actual machining of the boxes will naturally in most shops be done by the same methods prevailing for new work, of which the following may be mentioned.

Draw-cut Shaper.—This machine is provided with an arrangement in the ram for gradually revolving the cutting tool. In practice the box is held on the shaper table properly centered with the ram. After all is ready the cutting tool is set to the proper radius. As the machine makes a stroke the tool is rotated a small amount and so on until the work is completed.

Vertical Slotting.—This method is similar to the above except that the box is revolved instead of the tool. Either method admits of good workmanship when the machines are in a good state of repair. There is, however, always the possibility of the ram not being square with the work and machining one end of the box larger than the opposite end. To guard against trouble of this nature the boxes should be checked occasionally. This may be done with the three-prong calipers in Fig. 1. After the boxes are reslotted, or if it is not necessary to do this, the actual sizes of the box may be measured and a memorandum made of the actual sizes for the benefit of the workman turning the shell.

BOX FACE LINERS

For applying and machining the liners on the box faces several methods are followed both for brass and babbitt metal. When applying babbitt in some cases the practice is followed of pouring the babbitt the exact thickness desired.

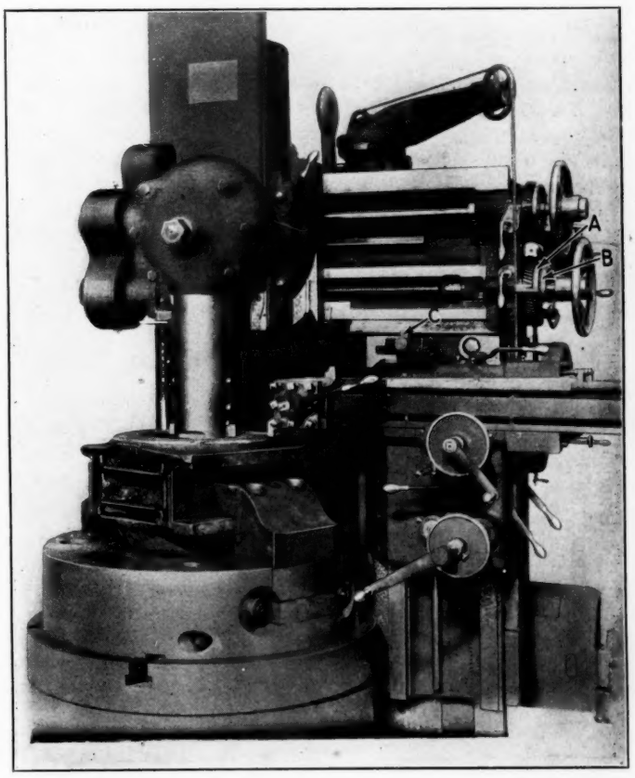


Fig. 5—Vertical Turret Lathe for Boring Driving Boxes

This is accomplished by locating a plate of boiler steel or cast iron the correct distance from the box and pouring the metal between the two. Where care is taken to locate the plate properly an excellent job may be made. A second method is to cast the babbitt somewhat thicker than necessary, which can be done by pouring from a ladle and without the use of a plate or other means of regulating the thickness of the babbitt. In this case it is necessary to machine the babbitt to the correct size. Where brass or bronze liners are used two methods may be followed, the use of either being governed largely by the design of the box on each particular road. In some cases the liners are faced on one side and secured to the box by flat-headed screws. In other cases the brass or bronze is cast onto the box. In either event, the liners are generally faced after applying.

In many respects the method of pouring these liners in the rough of either babbitt or bronze and facing them afterward will be found the more economical where proper machine tools are available for the purpose.

BORING AND FACING DRIVING BOXES.

For boring the shells and facing the liner several methods are followed, generally governed by the tool equipment available. The following methods are mentioned, which, however, do not cover the entire field.

Side Rod Boring Mills.—With this method the box is clamped on the machine table, the cutter for boring the shell being held in the revolving spindle and adjusted properly for the diameter required. A large sweep tool may also be used to face the babbitt liner. This method may be followed where better adapted machines are not available. It has the disadvantage that bronze liners cannot well be faced without a special facing tool and the bore and facing cannot be done at one time. Drill presses of heavy pattern are also used very similar to the method explained above.

Horizontal boring mills are also used for this purpose, the operation being very similar to that explained above, except that the box is set on its side instead of flat. This machine has the advantage that the table may be adjusted quickly to center the box.

Vertical boring mills of various forms are also made use of and are generally found more convenient than the other machines mentioned, having the advantage that the boring bar or tool may be readily adjusted for varying sizes of bore and either babbitt or bronze liners may be faced with an ordinary cutting tool. In the majority of cases the box is clamped on the mill table by the ordinary methods of clamping parts on these machines, which consumes considerable time in order to properly center the box.

Modifications of car wheel boring machines are also used for this purpose, in which event an adjustable tool is held

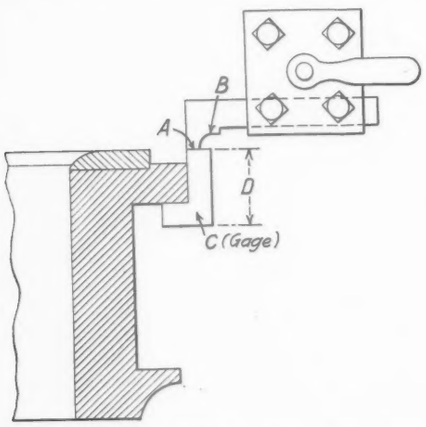


Fig. 6—Cutting Tool for Finishing Hub Liner Showing Use of Gages for Obtaining Proper Thickness

in the ram and the liner is faced by the facing attachments that are applied to these machines. Often special chucks are made to hold the box, with which it may be located and secured very quickly. This machine answers very well.

Vertical Turret Lathe.—For large and medium sized shops it will generally be found advisable to install a special vertical boring mill for boring and facing driving boxes and equip it with such chucks and special appliances as may be found desirable. At first glance this may appear extravagant. However, a careful review of the question will in many cases show that two or more machines are tied up on this work where one special machine will take care of the entire output. The so-called side head boring mill, or as sometimes called the vertical turret lathe, has been modified for this work. Fig. 5 shows a well known type of this machine fitted up specially for this work. As will be noticed on the illustration, the customary turret on the vertical ram has been replaced by a large single bar which is securely bolted to the seat for the turret. This bar, in order to secure rigidity, is made as large as possible, and on the machine illustrated it is seven inches in diameter and intended primarily for the larger driving boxes. For smaller boxes it would be necessary to reduce its diameter. At the lower end of this bar two cutting tools are held by set screws as shown. The tool at the right is used for roughing, and that at the left for the finishing cut. By always making use of one tool for the finishing cut the cutting edge will stand up for several

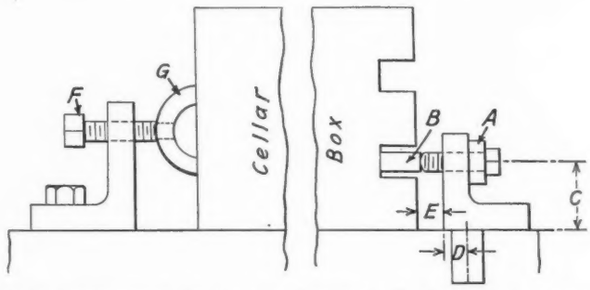


Fig. 7—Arrangement for Locating the Box with Respect to the Spring Saddle Pocket and for Holding the Cellar in Place While Boring

boxes and avoid too frequent settings of the tools. The hub liner is turned and the fillet formed by a specially formed cutting tool held in the side head, as shown in Fig. 5, and more in detail in Fig. 6. The facing of the liner is done with the cutting face *A* and the fillet by the concave cutting surface *B*.

In order to quickly locate the driving box a special two-jaw universal chuck, as shown quite clearly in Fig. 5, is used, the chuck jaws holding the box on the shoe and wedge surfaces, and as the two jaws tighten at a uniform rate, the box is located central with the center of the chuck. With this chuck it is unnecessary to measure the distances from the shoe faces to the center of the bore. The chuck is tightened by a square-headed screw clearly shown in the photograph. This screw operates two worm gears that are parts of the two right angle screws that close the jaws. The chuck is held on the table by T-bolts, the bottom surface of the chuck being keyed to fit the T-slots in the table. In practice these T-bolts are adjusted to allow free movement of the chuck on the table without lost motion. For readily adjusting the chuck to bore more or less from the crown of the brass an adjusting screw, not shown, is set in the mill table and works in a nut attached to the chuck, this screw being provided with a micrometer dial. By turning the screw, the chuck when holding the box may be set to run true or eccentric, as desired. This feature is valuable for reboring boxes having worn shells where only a small amount is to be removed to true up.

One feature incorporated on this machine that is worthy of mention is the method of setting the box with reference to the distance from the spring saddle pocket to the center of the bore of the shell. For boxes arranged for top saddle spring supports the boxes may all be set in the chuck the same distance from the saddle pocket to the center of bore, irrespective of the bore of the shell, without consuming any appreciable time in the set-up. A hole about two inches in diameter is bored in the chuck 13 in. from the center. A post, as shown in Fig. 7, fits into this hole. The post has a screw *A* with a large head, the point of which extends through the post a predetermined amount. The length of the screw and the distance *C* above the face of the chuck will vary with the different designs of boxes. The point of the

screw *A* bears against the block *B*, which fits in the spring saddle pocket and which is of a definite thickness. The method of determining the use and size of each of these parts can best be explained by an example. Let it be assumed that the drawings call for a distance of 10 in. from the center of the bore of the driving box to the spring saddle pocket. As previously mentioned, the hole in the chuck is 13 in. from the center or three inches from the hole to the pocket. Suppose the dimension *D* is 1½ in. and dimension *E* is ½ in. In this case the block *B* must be one inch, giving a total of three inches. Other designs of boxes will call for modifications of these distances.

For the purpose of holding the cellar in the box while the boring operation is going on, a post, shown at the left in Fig. 7, is permanently bolted to the chuck face. This is provided with a bolt *F*, having a loose U-shaped shoe *G* attached to its point. After the driving box is clamped in the chuck the bolt *F* is screwed up to hold the cellar in place. The box will now be located so that the two shoe faces are an equal distance from the center of the chuck and from the center of the boring mill table. The cellar will be in place so that it may be bored with the shell, and the distance from the bore to the spring saddle pocket will be correct.

Very good use may be made of the micrometer dials on this form of machine, with which the time of calipering may be

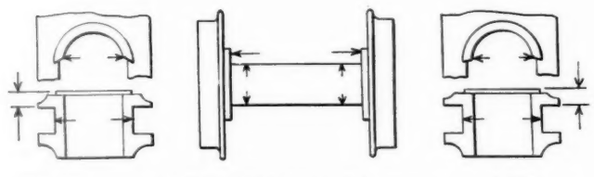


Fig. 8—Diagram for Recording Finished Dimensions for Driving Box Work

reduced to almost nothing. On the design in question two dials *A* and *B*, Fig. 5, are located on the cross screw. One of these dials is graduated right hand and the other left hand, each dial being independent of the other and arranged that they may be turned independently and clamped when properly set. The object of the two dials is to set one properly for the right hand or roughing tool in the boring bar, and the second for the left hand or finishing tool also set in the same bar, each dial being graduated to read to one-thousandth of an inch diameter. For the purpose of setting these dials a setting point *C* is arranged on the stationary part of the machine. In practice the boring bar is raised until the cutting tool is horizontal with the setting point and a pin bar of known length is set between the setting point and cutting tool. The cross screw is then turned until the pin bar just touches the setting point and cutting tool. The dial is then set with the zero mark to the pointer. The opposite cutting tool is then set in a similar manner with a *C*-gage. After setting the tools a trial cut is made on any box that may be on the machine, the bore measured and the dial given such slight corrections as may be necessary. With the dials once properly set any sized bore in the range of the machine may be made. That is, should it be necessary to bore a box 7, 7.5, 8, 8.070 or 9.120 in. the tools may be set by turning the cross screw until the dials read correctly and generally an accuracy of .005 in. will be obtained. It will readily be seen that a great amount of time may be saved by eliminating the calipering of each box as the boring operation is performed.

To insure facing the boxes correctly and to compensate for varying distances between the hub liners on the driving wheels and insure the correct amount of end play of the axles when assembled on the locomotive a very simple gage *C* may be used as shown in Fig. 6. This may be easily made from sheet steel about ⅛ in. thick. A separate gage is desirable for each class of driving box. The dimension *D* should be equal to the distance from the shoe space to the top of the liner on the driving box for a standard driving box made according to drawings and where proper allowances have been made for end play of axles.

This gage may be used in the following manner: Assuming that the distance between the hub liners is correct and the locomotive frame is also correct, the gage is held as shown in Fig. 6, and the cutting tool, held in the side head of the machine, is adjusted until it just touches the gage. The micrometer dial on the side head is then set to zero. This operation is repeated on the opposite side and should the two sides be nearly alike the average of the two may be taken. Should these two readings differ largely it may be necessary to plane the box in order that both shoe faces may bear equally on the shoes.

The liner may be faced by taking a roughing cut with the tool raised a small amount and the finishing cut with the micrometer dial back to zero. Should the distance between the hub liners on driving wheels be more or less than standard dimensions the tool is adjusted similar to that explained above, but when facing, the tool is raised or lowered the proper amount, which will be shown by the readings on the micrometer dial. For example, suppose the distance between the two hub liners is ⅛ in. above standard, owing to wear and refacing. This distance should be divided equally between the two driving box faces. In this event the facing tool would be raised one-half of ⅛ in. or .062 in. above the original setting. This amount may readily be ascertained by readings on the micrometer dial. Should the distance between the driving wheel liners be less the process would be reversed. This is a very simple operation and will be quickly understood by the machine operator.

MEASURING AND RECORDING SIZES.

For obtaining the correct size for boring the driving box shells the ordinary micrometer can be used to good advantage when measuring the axles. It will be found in practice that they are quicker to use than machinist's calipers and much more accurate, their great advantage being in the fact that the size measured may be recorded on a blank, as will be explained later. These micrometers are very useful for checking the axle for roundness and taper.

For measuring the distance between the hub liner faces on driving wheels the inside tubular micrometer may be used to good advantage. This measurement is essential in order to determine the correct amount the driving box liner should be faced to allow the proper amount of end play of driving wheels. It is advisable to bore the shell somewhat larger than the largest part of an axle worn taper or a new correctly turned axle. No well established rule appears to be followed for this amount. As a general proposition, if the box is bored from .015 to .025 in. larger than the axle the conditions of running will be found satisfactory.

Fig. 8 shows a form of card that may be used to good advantage for recording the desired finished dimensions for driving box work.

ROLLING STOCK FOR DANISH RAILWAYS.—The Danish State Railways for a long time have been in need of more freight cars and recently ordered 750 from the "Scandia" factory in Randers, Denmark. This will give work to 500 people who have been unemployed. A set of wheels for a freight car before the war cost $40, while now they cost $348.—*Commerce Reports.*

SAFETY PRECAUTIONS FOR HANDLING OXY-ACETYLENE APPARATUS*

BY E. WANAMAKER
Electrical Engineer, Rock Island Lines

Unabsorbed acetylene, that is, in a gaseous state as generated, is highly explosive at a pressure of two atmospheres or more due to the chemical instability of the gas itself. Acetylene is more or less unstable and liable to sudden explosive decomposition under certain circumstances. Accidents sometimes occur when it is apparently impossible to guess what precipitated the decomposition which resulted in the explosion. Acetylene gas at ordinary atmospheric pressure and temperature does not fly apart spontaneously and explosively into its constituents, but does so when exposed to considerable pressure while in a wholly gaseous condition as previously stated.

It has been ascertained that acetone has the property of being able to absorb about 25 times its volume of acetylene for each atmosphere of pressure at 60 deg. F. When acetylene is dissolved in this way it ceases to be spontaneously explosive and may be stored with acetone at pressures up to 250 lb. with comparative safety. Persons not fully acquainted with the properties of acetylene gas should under no conditions be permitted to undertake the compression of it.

Acetylene gas is comparatively non-poisonous when inhaled in highly diluted form in small quantities such as might escape from small leaks; the only poisonous effects that have been observed in connection with it were due to the presence of impurities in the gas, such as phosphoretted hydrogen. Therefore acetylene should always be secured as free as possible from phosphorous and other contaminating substances.

It has been found that one pound of carbide will generate 46 cu. ft. of acetylene gas, which if permitted to leak into a room six by six by five feet, will mix with the air in such a proportion as to make it an inflammable explosive that may be set off by a spark as well as by a hot iron or flame. For this reason it is always well when using an acetylene torch in a small enclosed space to see that a sufficient quantity of air is obtained to prevent accidents from such a cause. A little air blowing from an air hose will prevent any such accident as this even though considerable acetylene were leaking into the space.

Oxygen is manufactured directly as a chemical product or electrolytically from water. Oxygen itself as a gas is non-explosive. However, it is generally stored in metal containers at a very high pressure, generally about 1,800 lb. per sq. in. It is therefore apparent that an explosion may take place due to the failure of the container itself permitting the gas to rush out at an enormous velocity.

It has been found at times when oxygen was made electrolytically, that due to the crowding of the pressure or careless handling a small percentage of hydrogen was permitted to mix with the product. Certain proportions of this mixture are highly explosive and may be set off by heat or jar. It is therefore necessary that oxygen be pure.

The following instructions for handling oxy-acetylene gas are strongly recommended:

In handling acetylene gas in tanks under pressure it should be remembered that at no time should the tank be allowed to remain near stoves, furnaces, steam radiators or any other sources of heat nor should they be exposed unnecessarily to the direct rays of the sun. Care should also be used in handling acetylene gas containers to avoid heavy jars. It must be remembered that any steel drum is liable to mechanical injuries if not reasonably handled. Acetylene cylinders should always be stored in an upright position with the valve end up.

Leaking containers should never be used and should one be found, it should be set out in the open air as soon as possible away from all possibility of ignition of the gas or of the mixture of gas and air that surrounds the container.

Open flame lights should never be taken into confined spaces where there is any possibility of leakage of acetylene. In case it is found necessary to use an acetylene tank in a small enclosed space a little air should be blown into the space from an air hose in order to secure a good circulation of the atmosphere.

All acetylene containers should have fusible plugs.

Neither oxygen nor acetylene containers should ever be allowed to remain where they are exposed to sparks or flame.

Oxygen containers should not be dropped nor handled roughly in any way and should not be placed where they may be overturned by a collision with other objects or by reaction caused by the violent escape of their contents through the safety outlet with which containers should be provided.

The regulating devices, valves and other attachments on oxygen containers should never be lubricated with oil or grease. Whenever lubrication is required it should be secured by the use of pure graphite unmixed with either oil or grease. Furthermore the discharge valves of oxygen tanks should always be opened slowly and care should be taken to avoid twisting or straining them by the use of hammers or improper wrenches.

The hose and hose connections used between the gas manifolds or gas tanks and the welding torch must always be maintained free from leaks and all joints made mechanically tight and secure. The regulating valves and torches must be kept in a good state of mechanical repair to avoid leakage of the gases. No part of the equipment to which hose is attached should be used without securing the hose with the proper size hose clamp. Wire fastenings should not be used in any case.

In case of any trouble with the torch the gas should be immediately shut off at the tanks or pipe line station.

Where generating stations are used the instruction cards sent with the parts must be carefully followed and no leaks must be permitted on any of the pipe lines.

No man should be permitted to use the gas welding torch until properly instructed by a welding supervisor or some experienced welder and if he is not the regular operator permission of the foreman in charge should be obtained before the machines are used.

Safety gages should be used on all regulators, that is, gages having loose or vented backs, so that in case the pressure on the gage builds up to a dangerous degree or builds up too rapidly, such as might cause a rupture of the Bourdon tube the force will spend itself without breaking the glass case, thereby causing possible injury to the operator.

Some shops use portable welding outfits, purchasing tanked gas and tanked oxygen. Other shops install acetylene generating outfits, also oxygen generating outfits, piping the gas throughout the shops having manifold outlets to which the hose from the welding torches are connected. Still other shops generate acetylene gas and purchase tanked oxygen, connecting it to a manifold which in turn is connected with a system of piping in much the same manner as the oxygen generating plant. Each generating plant that is installed is equipped with a complete set of instructions for intelligently operating the generator, the most important of which are: "Remember to keep all light or fire of any kind away from the plant and never permit the generator to remain more than five minutes unless the generating chamber is filled with water, even when it is not in use." If the instructions that we have given in this paper and the detailed instructions which are given out with the generators are carefully followed out and leaks of all kinds prevented in the distribution piping system of the installed plants, there will be practically no danger from fire.

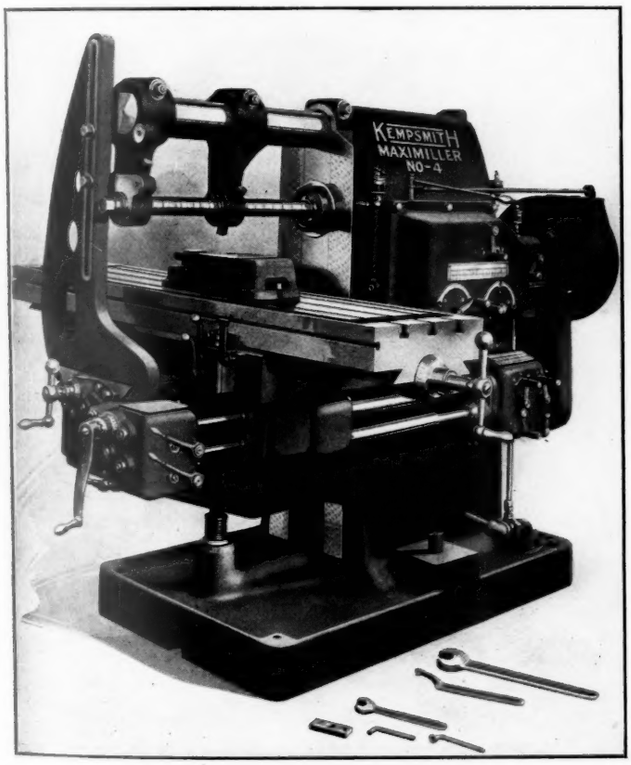
*Abstract of a paper read before the Railway Fire Protection Association on December 4.

NEW DEVICES

KEMPSMITH MAXIMILLER

The Kempsmith Manufacturing Company, Milwaukee, Wis., one of the first machine tool builders to make an all geared type of milling machine, has produced a new design of knee type milling machine called the "Maximiller." In designing the machine particular attention has been paid to insuring ease of operation and control with rapid production and accurate work.

Special material has been used in this machine in order to secure the adequate strength without excessive weight.

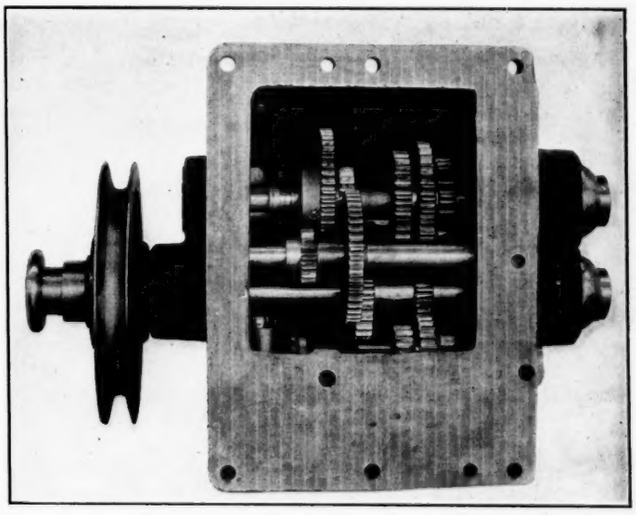


Heavy All-Geared Type Milling Machine

The spindle, gears and much of the shafting are made of heat-treated alloy steel. The column, knee, saddle and table are of semi-steel. The column is well ribbed and has few openings, and the knee is designed throughout to give the proper support to the saddle and table. The side walls are practically solid, having but two small openings, and the knee slide on the column is extended up beyond the top wall to provide extra resistance against strain. The top wall is solid, the cross feed screw being located in a shallow depression midway between the saddle Vees. The table is 18 in. wide with a working length of 72 in. The gibs in the saddle and table are of the adjustable taper type.

The over arm is a solid steel bar 5¼ in. in diameter, with a wedge lock which positively locates the pendants and alines the arbor, thus preventing any tendency to twist out of line under heavy cuts. The outboard support is of the open side type developed by this company, permitting free access to the table and the work at all times. It is reversible to bring the open space on either side as required.

The spindle is large in diameter and runs in adjustable phosphor bronze bearings. All other shafts in the speed transmission run on ball bearings. The driving force is applied to the spindle on a face gear which overhangs the front bearing, thus reducing the torsional strain in the spindle. As the face gear is the only slow speed member in the driving train, chatter is practically eliminated and the drive is smooth under heavy cuts. The speed changes are secured through a train of gears giving 18 spindle speeds ranging from 14 to 350 r. p. m. All speed changes are secured by sliding gears and there are never more than three pairs of gears in mesh. The normal direction of spindle rotation is right hand which makes it correct for standard drills and boring tools. A spindle reverse has been incorporated in the machine, for, in order to get the cutting strains in the proper direction on the gibs and the tables, the face mills must run in the opposite direction from the spiral or slab millers.



Feed Change Gears and Case, Showing Unit Construction

The principle of unit construction has been used to a considerable extent in the design, thus securing many advantages both in manufacturing and in repairing. The spindle speed change mechanism is an integral part mounted in a box se-

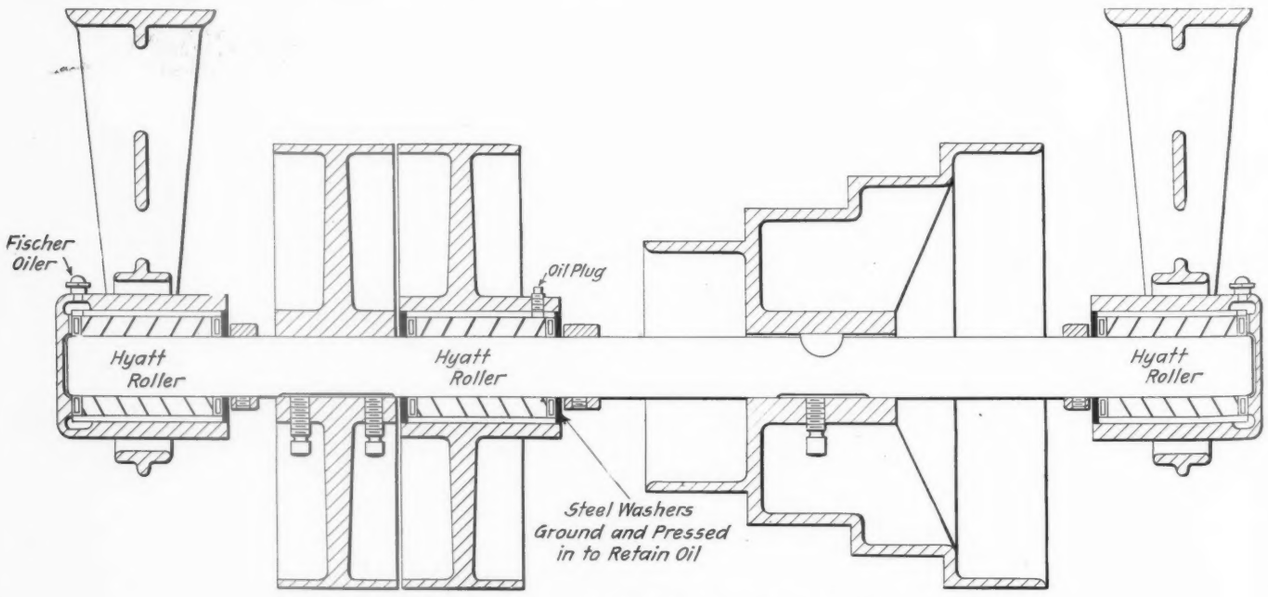
cured to the column and the feed change mechanism is an independent unit mounted below the driving gear. There are 18 feeds available ranging from 5/8 in. to 25 in. per minute. Only one clutch is used and there are no tumblers or locking pins, all changes being obtained by sliding gears. All the speed changes are secured with only three levers and a direct reading feed plate makes it easy to obtain any combination desired. Incorporated in the feed mechanism is a safety coupling which slips before a breaking load comes on the feed drive but resumes the travel again as soon as the load drops to safe limits. The power rapid traverse can be used for all table movement without disturbing the set-up for whatever rate of feed may be in use.

A centrifugal type pump with a capacity of 15 gal. per minute is attached to an extension of the feed drive shaft to circulate cooling compound. The pump is driven through a clutch which can be disengaged if the nature of the work does not require a cooling fluid. The lubrication of the parts has been given special consideration in this machine. The gears and bearings in the speed and feed mechanisms are lubricated by splash from an oil bath in the case. Sight feed oilers are used to supply clean oil to the spindle bearings and drive pulley. The lubrication of the mechanism supported by the knee is centralized at two points which makes it certain that none will be overlooked when the machine is oiled.

The driving pulley is 16¾ in. in diameter and runs at 400 r. p. m., a six-inch belt being used. For general railroad shop work a 15-h.p. motor is recommended for driving this machine.

ROLLER BEARING COUNTERSHAFT

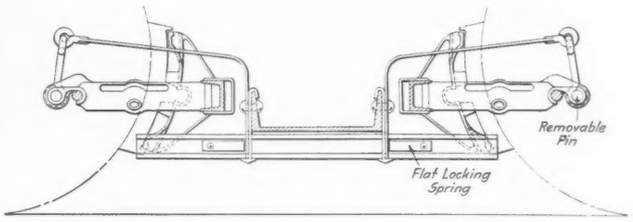
As a step in a program of refinement in its line of shapers, part of which has been carried into effect during the war, the Queen City Machine Tool Company, Cincinnati, Ohio, has designed a roller-bearing countershaft which will be included as part of the equipment of all shapers manufactured after March 1, 1919. As shown in the drawing, the countershaft hangers have been designed to include Hyatt roller bearings. The journal boxes are cast with the outer ends closed and the inner ends are closed with steel washers which are ground and pressed in to retain the lubricant. The loose pulley also runs on Hyatt rollers and both ends of this bearing are closed in the same manner as the inner ends of the journal boxes. The purpose of reducing the inefficiency with which power is transmitted from the line shaft to the machine has been carried out in a design the simplicity of which is intended to insure against any increase in the amount of inspection or attention required to keep it in satisfactory working order.



Roller Bearing Countershaft for Queen City Shapers

ATLAS SAFETY GUARD AND THIRD POINT SUPPORT

For some time past the American Steel Foundries, Chicago, has been manufacturing a safety device for brake beams known as the Atlas Safety Guard. This consists of a bar of I-Section fastened beneath the spring plank in such a position as it will support the brake beam in case the brake



Atlas Safety Guard and Third Point Support

hanger should fail or the pins fall out. A further improvement has been made in this device by providing an additional support for the brake beam to insure even brake shoe wear. This is accomplished by extending arms upward and outward from the safety bar support on the spring plank and fastening the brake beams to these arms by short links. In cases where one safety bar is used on each truck, these links are attached to the end of the brake beam strut; when two safety bars are applied the links are fastened to the tension member. The safety bars, as in the previous design, are held in place by flat springs and can readily be slid through the supports under the spring plank when it is desired to remove the brake beam. The arm and links being above the beam, do not interfere with its removal in any way.

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Exports of locomotives through the port of New York during December, 1918, amounted to $1,755,891, according to figures given in the monthly foreign trade records issued by the National City Bank. The report also shows rails exported to the value of $1,354,795 and car wheels and axles valued at $413,720. Freight cars are not separately shown in the tabulation.

The railways of India on March 31, 1914, had 170,444 freight cars. The number laid up for repairs at present is about 10,290, or about 6 per cent, of which 1,860, or about 1 per cent, of the total, were laid up for want of materials. The number is lower than in normal times, owing to the efforts the railways were making to keep every available freight car on the road. The number of cars sent overseas was 4,251, all of these except 56 were of metre or 2 ft. 6 in. gage.

The International Railway Congress has resumed its headquarters at Brussels with the return to that city of M. L. Weissenbruch, the general secretary. The Congress, before the war, held its meetings every five years, meeting in 1895 in London, 1900 in Paris, 1905 in Washington, 1910 in Berne, and the 1915 meeting was to have been held in Berlin. The Congress, before the war, also proved of service to railway men the world over by the publication at Brussels of a monthly bulletin.

The great scarcity of coal in Italy has made it necessary to use wood and lignites for fuel in locomotives. The boilers and fireboxes of the locomotives have had to be changed to suit the new fuel, and employees re-educated to a considerable extent. The use of substitutes for coal as fuel has been urged on all manufacturers, and prizes have been offered for noteworthy economies. In addition to that, two companies, with an initial capital of $1,200,000 each, have been formed for the development of lignite or brown-coal mines in Italy. One will operate mines in northern, the other in southern Italy.

The State Department at Washington has received through the American Legation at Brussels a request from the Belgium government asking the United States to lend it 400 locomotives and 2,000 cars in addition to returning all of the 359 locomotives which were placed at the disposal of the American Expeditionary forces. The communication from Minister of Railways Renkin, sets forth the urgent need for additional rolling stock in Belgium to replace that commandeered or destroyed by the Germans. The American army has returned 187 of the Belgian locomotives, but the remaining 172 still are in use by the Expeditionary forces.

Maximum prices on anthracite coal, together with all other coal and coke regulations except three, have been suspended by the Fuel Administration. The only restrictions not suspended, as to coke and all coal, are: Those requiring that contracts be made subject to maximum prices if reinstated, subject to cancellation by the Fuel Administration and subject to requisition or diversion of coal by the Fuel Administration. Those prohibiting reconsignments of coal. Those requiring shipments of coal to tidewater to go through the Tidewater Coal Exchange. The order includes the suspension of price and zone regulations on coke and bituminous coal which went into effect February 1. The administration's control of the oil industry already has been mostly suspended, so that the Fuel Administration's controls are now relaxed to the present limit of safety.

The Engineering Societies' Employment Bureau, New York City, desires that state and municipal authorities, corporations and individuals who need the services of professional engineers communicate their wants to the bureau, 33 West Thirty-ninth street. This bureau is maintained by the four national societies of civil, mining, mechanical and electrical engineers. In behalf of engineers who have been serving in the army or in government capacities during the war, it is the desire of the Engineering Societies to get in touch with contemplated engineering projects as early as practicable. By resolutions adopted unanimously (by the 650 members present at its annual meeting) the American Society of Civil Engineers has recorded "its profound conviction that public works should be carried forward to the fullest extent consistent with sound judgment, not only for fundamental economic reasons, but for humanitarian reasons."

Two new Safe Practices Bulletins of the National Safety Council have been published. No. 16 is a ten-page illustrated monograph on safe clothing for men and women in industry. These excellent brochures contain a large amount of useful information, gathered from varied sources and clothed in lucid and vigorous language. Some members of the Council, to encourage the wearing of suitable clothes, provide women employees with the first suit free of charge. Bulletin No. 18 is on Power Presses. The ingenious recent devices for preventing workmen from injuring their hands

or feet in these ponderous machines are innumerable. One picture shows a large press, in a shop of the Ford Motor Company, where each of two men must press an electric push button with each hand before the machine can be operated. These pamphlets are provided at a cost of ten cents each by the National Safety Council, 208 South La Salle street, Chicago.

Future of Gas and Electric Welding

At a joint meeting of the American Institute of Electrical Engineers and American Institute of Mining Engineers, on February 19, five papers were presented on the subject of welding, as follows: "Microstructure of Iron Deposited by Electric Arc Welding," by G. F. Comstock; "Path of Rupture in Steel Fusion Welds," by S. W. Miller; "Welding Mild Steel," by H. M. Hobart; "Electric Welding in Shipbuilding," by S. V. Goodall, and "Fusion in Arc Welding" by O. H. Eschholz.

A lively discussion followed their presentation during which it was suggested that as so much had been done in the way of making repairs, particularly by the railroads during the past two years, the time was ripe for bringing the welding processes permanently into the field of construction. It was pointed out that there are many variables to be determined in order to secure a good weld and that successful welding is dependent upon uniformity of results. For this reason it was stated that the welding operator must be both skilled and conscientious, and a diversity of opinion was expressed in the discussion as to whether the operator should be a skilled engineer or whether the average worker could be taught to do good welding work.

The particular significance of the presentation of the papers and the discussion lies in the fact that welding is demanding so much of the attention of our best engineers. This in itself is sufficient indication that the constantly increasing use of welding is to be expected. Conclusions indicated by the discussion were that both gas and electric welding had come to stay and that we may prepare for the time when the average mechanic must learn the use of the welder, just as he has had to learn the use of the hammer and chisel.

The Disposition of Surplus Government Material

Announcement was made in Washington on January 29 giving the details of the plan of organization of the Office of Director of Sales of the War Department as follows:

Under the director of sales, C. W. Hare, is an assistant, E. C. Morse, chairman of the Board of Sales Review, comprising the following members besides Mr. Morse: Lt. Col. A. LaMar, Major W. M. Crunden, Col. Fred Glover, L. H. Hartman, G. F. Woods, Capt. A. L. Mercer, Capt. T. S. Schultz. Each of these members of the board is a division sales manager with the exception of Captain Schultz, who is legal member on the board.

The announcement gives the names of seven divisions, the first of which, headed by Colonel LaMar, will handle machine tools, including all metal and woodworking tools, railway equipment, steam shovels, locomotive cranes, gantry cranes, hand tools, forging equipment, iron and structural workers' power tools and machinery.

The following is the tentative agreement reached by the government and the machine tool builders.

"1. The inventory of all machine tools and equipment which is being made will be expedited to the greatest possible extent.

"2. As soon as it is known that a quantity of machine tools is available for disposal, the manufacturers of these tools will be given an opportunity to purchase them at a price and on terms of settlement which will be satisfactory to all parties concerned.

"3. In case it is impossible for the manufacturer to purchase his product outright, an effort will be made to arrange for the marketing of the product in an equitable manner, securing for the government and the manufacturer alike the best possible terms.

"4. In case both these methods of disposition fail, the material will be offered for sale to the general public in a manner prescribed by law.

"In the settlement of plant contracts which involve the sale of large groups of various kinds of tools and equipment, an effort will be made to prevent the sale of any equipment for resale, as it is realized that great injury could be done by indiscriminate sales of this character."

Railway Regiments' Tobacco Fund

The Railway Regiments' Tobacco Fund, to which 146 railway supply companies contributed, made seven shipments of tobacco, amounting to approximately eight tons, to railway regiments in service in France. Owing to the congestion in the transport service during the summer on account of the great number of troops going over, it was found that this tobacco was not being delivered to the regiments to which it was consigned, and shipments were therefore postponed until the transport service could be organized to the point where delivery was assured; but the movements of the various railway regiments were so uncertain that it was finally decided not to make any further shipments. The total amount subscribed to this fund was $16,129.94, of which $10,056.05 was spent for tobacco, leaving $6,073.89 still in the hands of the committee handling the fund. This sum is approximately 37.5 per cent of the amount subscribed, and the committee, in making arrangements for the closing of the fund, has decided to return to the contributors 37.5 per cent of each subscription received. This will amount to practically all the funds available, with the exception of a few dollars, which will be utilized to defray expenses. In requesting subscriptions it was specifically stated that they were only to be made up to the end of the year 1918, and accordingly, all checks received since December 31, 1918, are to be returned.

RAILROAD CLUB MEETINGS

Club	Next Meeting	Title of Paper	Author	Secretary	Address
Canadian	Mar. 11	Varnish	Norman Holland	James Powell	P. O. Box 7, St. Lambert, Que.
Central	Mar. 14	Unified Inspection and Maintenance of Car Equipment	J. J. Tatum	Harry D. Vought	95 Liberty St., New York.
Cincinnati	May 13	Fuel Conservation	D. E. Dick	H. Boutet	101 Carew Building, Cincinnati, Ohio.
New England	Mar. 11	Annual Meeting and Entertainment, Election of Officers and Reports		W. E. Cade	683 Atlantic Ave., Boston, Mass.
New York	Mar. 21	Railway Supply Men's Night		Harry D. Vought	95 Liberty St., New York.
Pittsburgh	Mar. 28			J. D. Conway	515 Grandview Ave., Pittsburgh, Pa.
St. Louis	Mar. 14	Unification of Telegraph and Telephone Facilities	F. E. Bentley	B. W. Frauenthal	Union Station, St. Louis, Mo.
Western	Mar. 17	Mechanical Stoking of Locomotives, by W. S. Bartholomew. Address by Lt. Comm. D. C. Buell on U. S. Naval Railway Batteries in France		A. F. Stuebing	750 Transportation Bldg., Chicago.

The Railway Regiments' Tobacco Fund was initiated by F. A. Poor, president of the P. & M. Company, Chicago, and in order to raise the necessary funds, a committee was organized composed of Mr. Poor, as chairman; R. P. Lamont, president of the American Steel Foundries; George A. Post, president of the Standard Coupler Company; E. H. Bell, president of the Railway Supply Company; J. M. Hopkins, president of the Camel Company, Chicago, and A. C. Moore, vice-president, Safety Car Heating & Lighting Company. Samuel O. Dunn, editor of the Railway Age, was secretary of the committee, and John R. Washburn, vice-president of the Continental Commercial Bank, Chicago, acted as treasurer of the fund.

MEETINGS AND CONVENTIONS

Railroad Club of Washington.—One hundred and twenty employees of the Railroad Administration in the city of Washington have organized the Railroad Club of Washington. W. C. Kendall, manager of the Car Service Section of the Railroad Administration, was elected president.

American Steel Treaters' Society.—This association was recently formed for the announced purpose of promoting the arts and sciences connected with the heat treatment of steel. The principal means for this purpose is to be the holding of meetings for the reading and discussion of papers bearing upon processes, instruments, equipment, apparatus, etc., employed in practical and research work connected with the art, collection, publication, and dissemination of technical and practical knowledge for the improvement of conditions in connection therewith, and to closely unite those engaged in its practical and technical branches.

A monthly journal which brings the papers and discussions had at various meetings directly to the hands of every member is published. Comprehensive and valuable service features are also a growing part of the journal and of the society's activities. Sample copies and other information may be had by addressing the general office of the society, 154 East Erie street, Chicago.

In addition to meetings in Chicago, a chapter has been organized in Cleveland, and movements of this kind are now under way in several other large cities.

The following list gives names of secretaries, dates of next or regular meetings and places of meeting of mechanical associations:

AIR BRAKE ASSOCIATION.—F. M. Nellis, Room 3014, 165 Broadway, New York City. Convention, May 6-8, 1919, Chicago.

AMERICAN RAILROAD MASTER TINNERS', COPPERSMITHS' AND PIPEFITTERS' ASSOCIATION.—O. E. Schlink, 485 W. Fifth St., Peru, Ind.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—V. R. Hawthorne, 746 Transportation Bldg., Chicago. Convention, June 23-25, 1919, Atlantic City, N. J.

AMERICAN RAILWAY TOOL FOREMEN'S ASSOCIATION.—R. D. Fletcher, Belt Railway, Chicago.

AMERICAN SOCIETY FOR TESTING MATERIALS.—C. L. Warwick, University of Pennsylvania, Philadelphia, Pa.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—Calvin W. Rice, 29 W. Thirty-ninth St., New York.

ASSOCIATION OF RAILWAY ELECTRICAL ENGINEERS.—Joseph A. Andreucetti, C. & N. W., Room 411, C. & N. W. Station, Chicago.

CAR FOREMEN'S ASSOCIATION OF CHICAGO.—Aaron Kline, 841 Lawlor Ave., Chicago. Meetings second Monday in month, except June, July and August, Hotel Morrison, Chicago.

CHIEF INTERCHANGE CAR INSPECTORS' AND CAR FOREMEN'S ASSOCIATION.—W. R. McMunn, New York Central, New York, N. Y.

INTERNATIONAL RAILROAD MASTER BLACKSMITHS' ASSOCIATION.—A. L. Woodworth, C. H. & D., Lima, Ohio.

INTERNATIONAL RAILWAY FUEL ASSOCIATION.—J. G. Crawford, 542 W. Jackson Blvd., Chicago.

INTERNATIONAL RAILWAY GENERAL FOREMEN'S ASSOCIATION.—William Hall, 1061 W. Wabasha Ave., Winona, Minn.

MASTER BOILERMAKERS' ASSOCIATION.—Harry D. Vought, 95 Liberty St., New York. Convention May 26-29, Hotel Sherman, Chicago.

MASTER CAR BUILDERS' ASSOCIATION.—V. R. Hawthorne, 746 Transportation Bldg., Chicago. Convention, June 18-21, Atlantic City, N. J.

MASTER CAR AND LOCOMOTIVE PAINTERS' ASSOCIATION OF U. S. AND CANADA.—A. P. Dane, B. & M., Reading, Mass.

NIAGARA FRONTIER CAR MEN'S ASSOCIATION.—George A. J. Hochgrebe, 623 Brisbane Bldg., Buffalo, N. Y. Meetings, third Wednesday in month, Statler Hotel, Buffalo, N. Y.

RAILWAY STOREKEEPERS' ASSOCIATION.—J. P. Murphy, Box C, Collinwood, Ohio.

TRAVELING ENGINEERS' ASSOCIATION.—W. O. Thompson, N. Y. C. R. R., Cleveland, Ohio.

PERSONAL MENTION

GENERAL

C. L. BUNCH, shop superintendent of the Southern Railroad, at Spencer (N. C.) shop, has been promoted to master mechanic of the Memphis division, with office at Sheffield, Ala., succeeding J. W. Gibbs, resigned.

J. L. CARVER has been appointed engineer of tests of the Illinois Central and the Yazoo & Mississippi Valley, with headquarters at the Burnside shops, Chicago, to succeed M. W. Kramer, deceased.

ALBERT H. EAGER, assistant superintendent of rolling stock of the Canadian Northern, Western lines, with headquarters at Winnipeg, Man., has been appointed mechanical superintendent of the Canadian National, with office at Winnipeg. Mr. Eager was born at Waterloo, Que., in 1868, and entered railway service as a machinist apprentice with the Canadian Pacific at Farnham, Que., in 1885. He remained with the Canadian Pacific until 1910, being successively machinist, locomotive foreman, general foreman at Cranbrook, B. C., and at Calgary, Alta, district master mechanic at Kenora, Ont., and again locomotive foreman at Calgary. In 1910 he went to the Canadian Northern as superintendent of shops at Winnipeg, and in 1915 became assistant superintendent of rolling stock of the Canadian Northern, Western lines, at Winnipeg, which position he held until his appointment as mechanical superintendent of the Canadian National.

WILLIAM F. KEISEL, JR., assistant mechanical engineer of the Pennsylvania Railroad, Eastern lines, has been appointed acting mechanical engineer, with office at Altoona, Pa., succeeding A. S. Vogt. Mr. Keisel was born on September 1, 1866, at Scranton, Pa., was educated in Lehigh Preparatory School, and in 1887 graduated from Lehigh University with the degree of mechanical engineer. He entered the service of the Pennsylvania Railroad as a draftsman, in the office of the mechanical engineer in April, 1888, and was promoted to chief draftsman in March, 1899. On July 1, 1900, he was appointed assistant engineer, and in September, 1902, he became assistant mechanical engineer, in which capacity he also had charge of the test department at Altoona until the separation of the two departments. Mr. Keisel's appointment as acting mechanical engineer of the Pennsylvania Railroad, Eastern lines, became effective on February 1.

W. F. Keisel, Jr.

T. J. LOWE, fuel agent of the Canadian Northern, Western lines, has been appointed fuel agent of the Canadian National, Western lines, with headquarters at Winnipeg, Man.

J. A. SUTTON, fuel and tie agent of the Transcontinental division of the Canadian Government Railways, has been appointed district fuel agent of divisions No. 1 and 2 of

the Central district, Canadian National, Western lines, with headquarters at Cochrane, Ont.

H. Weitzel, master mechanic of the Arizona Eastern at Phoenix, Ariz., has been appointed trainmaster with office at Globe, Ariz., succeeding A. D. Rosecrans.

George W. Rink, mechanical engineer of the Central of New Jersey, has been appointed assistant superintendent of motive power, with office at Jersey City, N. J. Mr. Rink was born on September 4, 1875, at New York, and was graduated from Cooper Institute, New York City, with the degrees of B. S. and M. E. He began railway work on March 14, 1892, as a machinist apprentice on the Erie Railroad. From March, 1896, to March, 1899, he served as a machinist and shop draftsman, and then to September, 1900, as a draftsman on the Northern Pacific. He then entered the service of the Central of New Jersey, as a draftsman and from 1901 to 1902, was roundhouse foreman and inspector of new equipment. Later he was engaged in road testing of locomotives and as draftsman, until 1903, when he was promoted to chief draftsman. From April, 1904, to January, 1909, he was instructor of apprentices, and then was appointed mechanical engineer, which position he held until his recent appointment as assistant superintendent of motive power.

G. W. Rink

Axel S. Vogt, mechanical engineer of the Pennsylvania Railroad, Eastern lines, with office at Altoona, Pa., retired under the pension rules of the road on February 1. He was born on January 19, 1849, at Christianstad, Sweden, and was educated in the public schools. He began railway work in June, 1874, with the Pennsylvania Railroad at Altoona, and remained with that road until 1882, when he went with Schutte & Koehrting, Philadelphia, Pa. In November, 1883, he returned to the service of the Pennsylvania Railroad as assistant engineer of tests. On March 1, 1887, he was promoted to mechanical engineer, and from that time until his retirement he served continuously in that capacity. The total length of his service with the Pennsylvania Railroad was a little more than 43 years, during which time freight and passenger cars passed through the transitory stage from wood to steel construction and locomotives increased in capacity fourfold and more, and the designs developed under Mr. Vogt's direction had considerable influence on their progress.

A. S. Vogt

MASTER MECHANICS AND ROAD FOREMEN OF ENGINES

W. C. Barr has been appointed general roundhouse foreman of the Erie at Meadville, Pa., succeeding H. C. Eckardson, resigned.

W. E. Beck has been appointed road foreman of engines of the Erie Railroad with office at Meadville, Pa., succeeding Bert Hill, transferred.

James Carney has been appointed general foreman of the Erie Railroad at Newburgh, N. Y

H. A. English, master mechanic of the Central district, Canadian Northern, has been appointed master mechanic of the Central district of the Canadian National, with headquarters at Winnipeg, Man.

R. E. Line has been appointed roundhouse foreman of the Erie Railroad at Kent, Ohio.

Andrew McCowan, supervisor of car works of the Canadian Northern system at Winnipeg, Man., was appointed master car builder of the Canadian National Railways, Western lines, with the same headquarters, at the time of the recent assimilation of the former road by the latter. Mr. McCowan was born at Perth, Scotland, on December 5, 1867, and was first employed by the Perthshire Carriage Works (Scotland), as an apprentice car builder, between 1881 and 1887. He began his railroad experience in May, 1888, as a carpenter on the Canadian Pacific at Montreal, Que. In March, 1890, he was promoted to car foreman, and seven years later he was appointed shop foreman at Farnham, Que. From September, 1903, to April, 1910, he was car foreman at Cranbrook, B. C., and on the latter date left the Canadian Pacific to become general car foreman of the Canadian Northern at Winnipeg, Man. He was promoted to supervisor of car works, Western lines, in September, 1915, and in May, 1916, had his jurisdiction extended over the entire system.

A. McCcwan

H. G. Reid, assistant superintendent of rolling stock of the Canadian Government Railways at Transcona, Man., has been appointed general master mechanic of the Canadian National, Western lines, with offices at Winnipeg, Man.

L. G. Roblin, general master mechanic of the Canadian Government Railways, Western lines, with offices at Cochrane, Ont., has been appointed master mechanic of the Prairie district of the Canadian National, with offices at Saskatoon, Sask.

PURCHASING AND STOREKEEPING

A. E. Cox, general storekeeper of the Canadian Northern, Western lines, has been appointed general storekeeper of the Canadian National, Western lines, with headquarters at Winnipeg, Man.

W. D. Manchester, chief engineer of the Manistee & Northeastern, with office at Manistee, Mich., has been appointed purchasing agent to succeed E. H. O'Neil, who has resigned.

SUPPLY TRADE NOTES

J. H. Regan, assistant secretary of the Pressed Steel Car Company, has been transferred from the New York to the Chicago office of that company.

The eastern branch of the Independent Pneumatic Tool Company, Chicago, has been moved from 170 Broadway to larger quarters at 1463 Broadway, New York.

George N. VanSweringen, sales representative, has been appointed assistant to the vice-president of the Chicago Railway Equipment Company, with headquarters at Chicago.

On January 1 the Duntley-Dayton Company took over the entire output of the Dayton Pneumatic Tool Company, of Dayton, Ohio, and announced its entry into the pneumatic tool field. W. O. Duntley, former president of the Chicago Pneumatic Tool Company, is president of the new concern and his son, Capt. C. A. Duntley, is vice-president. Captain Duntley has not yet been relieved of his command in the 27th United States Field Artillery. The Dayton line of pneumatic tools has been on the market for many years. A new plant, equipped with modern machinery, has just been completed to take care of the business of the company.

W. O. Duntley

In addition to handling the output of the Dayton Pneumatic Tool Company, the Duntley organization is putting out a complete line of portable electric drills and grinders, as well as a full line of accessories, such as hose and hose couplings, rivet sets and chisel blanks. W. O. Duntley is one of the pioneers in the pneumatic tool business and has been closely connected with the industry for the past 25 years. He has a number of pneumatic and electric tool inventions to his credit, the Duntley electric drill being, perhaps, the most widely known. The offices of the Duntley-Dayton Company are located in the Westminster building, Chicago; the eastern offices are at 295 Fifth avenue, New York, and the Philadelphia branch in the Commercial Trust building.

Lieut.-Col. R. P. Lamont, division chief of ordnance department, with headquarters at Washington, resumed his duties as president of the American Steel Foundries at Chicago on February 1.

J. D. Corby has resigned as St. Louis district manager of sales for the Chicago Pneumatic Tool Company and has assumed the active management of the Corby Supply Company, of St. Louis.

W. R. Colklesser has been appointed purchasing agent of the Gadsden Car Works, Richmond, Va., succeeding W. F. H. Finke, resigned to accept service with the United States Railroad Administration.

Millard F. Cox, assistant superintendent of machinery of the Louisville & Nashville at Louisville, Ky., has become associated with the Louisville Fire Brick Works, Inc., of Louisville, as vice-president and consulting engineer.

William G. Denney, treasurer of the Standard Car Truck Company, Chicago, died on February 7, at his home in Millerton, N. Y., at the age of 65 years. Mr. Denney had been with the Standard Car Truck Company since its organization.

The Patterson Sargent Company, Cleveland, Ohio, is now represented by L. J. McComb as railroad paint and varnish salesman, with office at 201 Devonshire street, Boston, Mass. Mr. McComb succeeded F. Howard Childs, who died December 15, 1918.

W. W. Butler, vice-president of the Canadian Car & Foundry Company, Montreal, Que., has been appointed president. Mr. Butler is also president of the W. W. Butler Company, Ltd., and a director of the Page-Hersey Iron Tube & Lead Company.

Fred M. Egolf, who has been associated with the Acme Railway Supply Company and the Acme Steel Goods Company, has been appointed western railway and marine sales representative of the Glidden Company, Cleveland, Ohio, with headquarters in Chicago.

The Interstate Car Company, Indianapolis, Ind., is erecting a steel car and tank car repair shop and fabrication plant at Indianapolis, Ind. The building will be of structural steel, 83 ft. by 245 ft., and 40 ft. high, costing approximately $50,000. George J. Dive is in charge.

W. S. Quigley, president of the Quigley Furnace Specialties Company, Inc., New York, sailed for Liverpool on February 15, for the purpose of further developing European connections of his company. Mr. Quigley will spend several weeks in England, France and Italy, and visit the plants installing the Quigley system for preparing and burning pulverized coal and lignite.

Ezra S. Taylor, assistant to the vice-president of the Pullman Company, has been elected assistant to the president, with office in the Pullman building, Chicago. Mr. Taylor was born at Chicago in 1880. When 17 years old he entered the employ of the Atchison, Topeka & Santa Fe as a member of a surveying gang in Texas. After three years in this work, he came to the Chicago office of the Santa Fe as a clerk in the freight department, and in 1900 he entered the employ of the Pullman Company as a clerk in the auditing department. From 1902 to 1905 he was assistant to the storekeeper, and later to the operating superintendent of the Chicago Elevated Lines at Chicago. The following three years he was assistant purchasing agent for the Western Steel Car & Foundry Company, at Anniston, Ala., and later at the Hegewisch (Ill.) plant. To increase his knowledge of the steel business, Mr. Taylor subsequently entered the employ of the Illinois Steel Company at its open hearth plant in South Chicago, where he remained for one year. In 1909 he returned to the Pullman Company as chief clerk in the sales department, and was subsequently general eastern agent at New York and assistant to the vice-president, which position he held until his appointment as assistant to the president on February 6, 1919.

E. S. Taylor

W. W. Hayward, secretary and treasurer of the Butler Drawbar Attachment Company, Cleveland, Ohio, died of pneumonia on February 12. Mr. Hayward had served as secretary and treasurer of the company since its organization. He has been succeeded by W. B. Waggoner.

The Chicago Pneumatic Tool Company, Chicago, has established a branch office at St. Louis, Mo., under the management of H. W. Buker, who succeeds J. D. Corby as district manager of sales. A stock room and service station will be maintained at St. Louis, as well as the district office.

C. C. Farmer, until recently assistant western manager and resident engineer for the Westinghouse Air Brake Company, has been advanced to the position of director of engineering of the same company with which he has been connected for many years. He was born in California, where he received his education. After a number of years as machinist on the Southern Pacific, he began, in 1891, a study of brake action and train control in the Westinghouse Air Brake Company instruction car, on various roads throughout the country. In the same year, the Missouri, Kansas & Texas offered him the position of supervisor of air brake repairs, from which he was advanced in a few months to air brake inspector of the entire road. In 1896 he became general air brake instructor of the Central of New Jersey and soon after became an inspector for the Westinghouse Air Brake Company. Not long after his second association with the Westinghouse Air Brake Company he was transferred to the Chicago district as mechanical expert. Then he was appointed resident engineer, and later, with the understanding that he would still retain the title of resident engineer, he was made assistant western manager, from which dual position he has now been advanced to that of director of engineering.

C. C. Farmer

A. W. Preikschat, formerly assistant to the engineer of tests of the Pullman Company, and later special representative in the purchasing department of the Steel Tube Company of America, has been appointed sales representative of the Liberty Steel Products Company, Inc., with offices in the McCormick building, Chicago.

W. Jerry Stanton has resigned as sales manager of the Railway Improvement Company to become special representative of the National Railway Appliance Company, New York. Mr. Stanton was employed by the General Electric Company for a period covering 18 years in the testing, engineering and sales departments.

At the organization meeting of directors of the Air Reduction Company, Inc., New York, held on February 19, the following officers were elected: President, A. S. Blagden; vice-president, A. R. Ludlow; treasurer, C. E. Adams; secretary, M. W. Randall; assistant treasurer, C. L. Snow, and assistant secretary, C. C. Emerson.

The Rich Tool Company, Chicago, announces the appointment of J. L. Crowley as special railroad representative, with headquarters at the company's main offices, Railway Exchange building, Chicago. H. W. Ullman has been appointed sales representative in the St. Louis territory, with offices at 203 Security building, St. Louis, Mo.

Fred Mathews, sales representative of the Union Metal Products Company at Chicago, has been appointed southern manager of the Standard Railway Equipment Company, the Pressed Steel Manufacturing Company, the Imperial Appliance Company and the Union Metal Products Company, with headquarters in the Candler building, Atlanta, Ga.

The Quigley Furnace Specialties Company, New York, has opened a branch office in the Turks Head building, Providence, R. I., in charge of F. W. Reisman, who has been the company's eastern New England representative for Hytempite, a high-temperature, firebrick cement, and insulating brick, as well as the Quigley air transport system for distributing and burning powdered coal and other fuels.

Huntly H. Gilbert, who left the service of the Pressed Steel Car Company and Western Steel Car & Foundry Company at the start of the war to enter the army as captain in the Ordnance Department at Washington, and later was commissioned major and transferred to the Rock Island Arsenal, has re-entered the service of the above named companies, as assistant manager of sales for the western district, located at 425 Peoples Gas building, Chicago.

W. B. Gibson, manager of the mining machinery department of the Allis-Chalmers Company, of Milwaukee, Wis., has been appointed manager of the small tank department of the William Graver Tank Works, Chicago, and R. C. Huntington, manager of sales promotion of the Fuller Rubber Company, Hampton, Ohio, has been placed in charge of department of sales, promotion and advertising of the William Graver Tank Works at Chicago.

George Sherwood Hodgins, of the editorial staff of Railway and Locomotive Engineering, died at his home in New York on January 18, at the age of 59 years. A graduate of the Upper Canada College and the School of Applied Science, affiliated with the University of Toronto, he afterward served an apprenticeship in the Kingston Locomotive Works. After some experience in a division master mechanic's office on the Canadian Pacific, he was advanced to various positions on the road, and latterly was locomotive inspector on the entire system. He was recalled to the Kingston Locomotive Works as mechanical engineer. Later he entered the service of the Pressed Steel Car Company as general inspector of the output of that plant, and was also for some years inspector for the Richmond Locomotive Works. During these earlier years he had contributed to a number of railroad publications. In 1900 he entered the field of practical journalism as editor of the Railway Digest. In 1902 he joined the staff of Railway and Locomotive Engineering, as associate editor, and in 1908 became managing editor, which position he held till 1911, when he was called by the Canadian government to make a comprehensive report on the shops, appliances, tools and equipment necessary for the Trans-Continental Railway. On the completion of that work in 1915, Mr. Hodgins joined

G. S. Hodgins

the staff of the Railway Periodicals Company as managing editor of the Railway Master Mechanic and Railway Engineering and Maintenance of Way. In 1916 he returned to Railway and Locomotive Engineering and remained on the staff as editor until his death, besides contributing to popular science magazines.

P. C. Cady, office manager of the mechanical department of the New York Central at New York, has been appointed assistant secretary of the International Railway Supply Company, New York, which is the purchasing agent for the American Railroad Company of Porto Rico and the Trinidad Government Railways, and also the export department of the Pyle-National Company. Mr. Cady was in railroad service since 1893, when he entered the mechanical department of the Lake Shore & Michigan Southern at Cleveland, Ohio.

John S. Y. Fralich has been appointed resident engineer of the western district for the Westinghouse Air Brake Company, succeeding C. C. Farmer. Mr. Fralich has been with the Westinghouse Air Brake Company since 1904. He was born at Harrisburg, Pa., September 19, 1880, was educated in the grade and high schools of Philadelphia, and received his engineering training at Williamson School. He then served a regular three years' apprenticeship as a machinist and was employed for two years as a machinist in the Altoona shops of the Pennsylvania Railroad. He became connected with the Westinghouse Air Brake Company in June, 1904, having been hired as a machinist, and shortly thereafter assigned to the inspection force. He was then respectively shop inspector, special inspector with the experimental test department, supervisor of shop tests and acting assistant to the mechanical engineer. He did special engineering work in the Chicago office from March to December, 1913, was appointed assistant resident engineer in December, 1913, and resident engineer of the western district February 1, 1919, as above noted.

J. S. Y. Fralich

Randolph S. Reynolds, secretary of the Curtain Supply Company, Chicago, died of pneumonia on January 20. Mr. Reynolds was with the Curtain Supply Company since 1912. Prior to that time he was with the Western Steel Car & Foundry Company, at Anniston, Ala., and the Pressed Steel Car Company, at Pittsburgh, Pa., having been connected with their purchasing departments from 1905 to 1912. He left the Pressed Steel Car Company in 1912 to accept a position with the Curtain Supply Company, and later was made assistant to general manager, and on April 30, 1918, was elected secretary to succeed Holmes Forsyth, who on that date became president.

The American Arch Company, New York and Chicago, announces the appointment of the following as traveling engineers of the company: E. S. Nicholas, with headquarters at Detroit, Mich., formerly boilermaker foreman of the Missouri Pacific shop at Kansas City, Mo.; M. R. Smith, with headquarters at St. Louis, Mo., formerly master mechanic at Coxton, Pa., on the Lehigh Valley; H. Darby, with headquarters at St. Paul, Minn., formerly motive power inspector of the Grand Trunk Pacific at Transcona shop, Winnipeg, Man., and J. D. Brandon, with headquarters at Montreal, formerly general foreman at the Brightwood shops, Indianapolis, Ind., of the Big Four. E. T. Mulcahy has again assumed his duties as traveling engineer of the American Arch Company, having been honorably discharged from the United States Army. Mr. Mulcahy's headquarters will be at Denver, Colo. Before coming with the American Arch Company Mr. Mulcahy was connected with the Union Pacific at its Cheyenne, Wyo., shops.

Railroad Administration Takes Over Superheater Company

Director General Hines announced on February 18 that the United States Railroad Administration, at the instance of the alien property custodian, had purchased more than 51 per cent of the stock of the Locomotive Superheater Company. According to Mr. Hines' statement, this stock originally belonged to German interests. The alien property custodian suggested that the interests of this government could be best protected through some governmental agency acquiring the stock. The purchase by the Railroad Administration will prevent effectively the passing of the stock back to German control.

At the annual meeting of the Locomotive Superheater Company, held at the office of the company, 30 Church street, New York City, the following directors were elected: J. S. Coffin, chairman; S. G. Allen, George L. Bourne, H. B. Spencer, Sanford H. E. Freund, J. N. Wallace, F. W. Scott, T. C. Powell and Henry Morgenthau. Five of these, Messrs. Spencer, Freund, Wallace, Scott and Powell, are representatives of the Railroad Administration.

It was announced that as the affairs of the company have been satisfactorily managed by its officers, no change was made in the management. George L. Bourne, R. M. Osterman, F. A. Schaff and S. G. Allen were re-elected, respectively, president, vice-presidents and secretary; Henry Morganthau was elected treasurer, and T. C. Powell, director of the Division of Capital Expenditures of the Railroad Administration, was elected an additional vice-president of the reorganized company.

The Pulverized Fuel Equipment Corporation

The Pulverized Fuel Equipment Corporation has recently been organized for the purpose of taking over the business of the Locomotive Pulverized Fuel Company, and to broaden the activities of the latter to cover the central power station, metallurgical and industrial fields. The head offices are at 30 Church street, New York, with Canadian office in the Transportation building, Montreal.

This corporation installs and delivers in operation complete plants of its "Lopulco" system for the preparation, distribution, storage, feeding and burning of pulverized fuel for any steam generating or heating purposes whatsoever. The development by the Locomotive Pulverized Fuel Company of its "Lopulco" system for the burning of anthracite and bituminous coals, lignite and peat in pulverized forms, has already commercially demonstrated its adaptability for not only steam locomotives and steamships, but for central power station and other direct and waste heat stationary boilers, and for metallurgical and chemical furnaces and cement and other kilns. Many such installations are now in use and in process of construction in connection with public utility properties and large industrial and manufacturing plants.

The officers of the Pulverized Fuel Equipment Corporation will be: J. S. Coffin, chairman; J. E. Muhlfeld, president; H. F. Ball, executive vice-president; H. D. Savage, vice-president in charge of sales; V. Z. Caracristi, vice-president in charge of engineering; Samuel G. Allen, secretary-treasurer.

CATALOGUES

TANKS.—Bulletin 259 of the Walter A. Zelnicker Supply Company, St. Louis, Mo., contains a revised list of new and used tanks of all kinds and sizes that are for sale by this company.

THREADING MACHINES.—The complete line of threading machines for bolts, nuts and pipe, manufactured by the Greenfield Tap & Die Corporation, Greenfield, Mass., is described and illustrated in Catalogue 41, which also gives the specifications for the machines and detailed information regarding parts for threading machines.

ELECTRIC DRILLS.—A four-page folder descriptive of the Thor line of portable electric drills and grinders has been issued by the Independent Pneumatic Tool Company, Chicago. These drills can be operated on either direct or alternating current. The bulletin contains a table showing capacities, speeds, dimensions, etc., of the various sized tools.

POWDERED COAL TRANSPORT SYSTEM.—Bulletin 10, a four-page pamphlet issued by the Quigley Furnace Specialties Company, New York, describes the Quigley air transport system for transporting and burning powdered fuel and contains several illustrations showing the operation of the system and the difference in structural work between a screw conveyor installation and the air transport system.

GRAPHITE PRODUCTS.—A new pocket catalogue has been issued by the Joseph Dixon Crucible Company, Jersey City, N. J., entitled "Dixon's Graphite Products." While not a complete catalogue, it furnishes a good idea of the variety of products made by this company. Pages are devoted to lists of articles especially for mills, railroads, automobiles, etc., with brief descriptions. Pamphlets dealing in detail with any one product may be had upon request.

WRENCHES.—The Coes Wrench Company, Worcester, Mass., has issued a 14-page catalogue dealing with the line of screw wrenches and accessories made by this company. These include steel, knife and hammer handle wrenches. Information is given regarding their construction, manufacture and strength compared with other wrenches, as shown by tests made at the Harvard University testing laboratory. The catalogue contains a number of illustrations.

STEAM ENGINE.—A detailed description of a high speed, piston-valve steam engine manufactured by the Ingersoll-Rand Company, New York, is contained in Bulletin No. 9026, issued by that company. This engine is of the horizontal center crank type and is known as class "F P." The details of the machine are fully described and are shown in a number of illustrations. Four sizes are specified, ranging from 6 in. by 6 in. cylinders to 14 in. by 12 in. cylinders, and brake horsepower from 12 to 81.

OXY-ACETYLENE WELDING.—The Air Reduction Sales Company, New York, has published an attractive booklet, containing an outline of a short course for colleges and technical schools in oxy-acetylene welding and cutting, prepared by Alfred S. Kinsey, professor of shop practice and head of the department of shop practice at Stevens Institute of Technology, Hoboken, N. J. This was prepared to meet requests from college instructors for suggestions as to the best course to follow in teaching this subject.

FLANGING.—An attractive catalogue entitled, "A Solution of Your Flanging Problems," containing 30 pages, 9 in. by 12 in., has been issued by the McCabe Manufacturing Company, Lawrence, Mass., illustrating and describing the wide range of work that can be done on the McCabe flanging machine, and showing economies that may be effected by its use. The greater part of the book is given over to illustrations showing finished products, such as various kinds of tanks, locomotive firebox and boiler sheets, steel car parts, etc.

BOILERS.—"Boiler Logic" is the title of an 86-page treatise on steam boilers prepared by the Heine Safety Boiler Company, St. Louis, Mo. Six topics are discussed as follows: Some fundamental considerations of boiler design; practical baffling of water tube boilers; Heine boilers for different fuels, firing and services; overloads; the boiler as a pressure vessel, and details of construction of Heine boilers. A number of illustrations accompany the text, including a supplement in color of a Heine boiler set over an underfeed stoker.

BELT FASTENERS.—The Crescent Principle of Belt Joining is the title of a four-page bulletin issued by the Crescent Belt Fastener Company, New York, describing the fasteners made by this company for joining all kinds of belting. These are claimed to give a flush joint, allowing the belt to have continuous contact with the pulleys. Several illustrations show completed joints with the various kinds of fasteners. The method of making the joints is also explained and illustrated. A ready reference chart, by means of which a belt man or machinist can readily determine the correct type of belt fastener to use for any condition of service is included in the bulletin.

RAILROAD WATER SOFTENING.—The Wm. Graver Tank Works, Chicago, has issued a treatise on the subject of water softening which consists of a collection of 31 reprints of full-page advertisements which are unusual in that little or no reference is made to any particular make or type of water softener, the material being almost entirely in the nature of a comprehensive exposition of the entire subject. Of particular note are 12 sheets presented in the form of articles covering various phases of this subject, prepared by W. R. Toppan, manager of the railroad department of the Wm. Graver Tank Works. These appear with such titles as "Operating Efficiency Increased by Purifying Water," "Water Softening in Relation to Ton Mileage," "The Method of Water Treatment Determines the Uniformity of Results." In addition to these 31 pages there is an eight-page appendix on the chemistry and economics of water softening. This serves to combine in a very short space a large amount of information required by the water service engineer in solving the problems arising in his work.

FORGE SHOP EQUIPMENT.—The Erie Foundry Company, Erie, Pa., has issued Catalogue F, containing 43 pages 8½ in. by 11 in., describing the Erie steam forging hammers, steam drop hammers, trimming presses and sheet galvanizing and shearing machinery. This catalogue is attractively arranged and contains a large number of illustrations. Two pages are devoted to each machine, one containing a description of the construction and the other an illustration of the machine with a table of specifications. Other illustrations show forgings made under Erie steam drop hammers and installations of this equipment in industrial plants. Several special features of design are separately described and illustrated, including a safety device for the protection of the operator from injuries caused by the breakage of top cylinder heads, an improved construction of guides and guide bolts which makes it unnecessary to remove the guide from the frame, an improved sow block or anvil cap, which eliminates the possibility of its working loose, and a throttle control. There are also several pages of instructions for erecting, operating and adjusting the Erie hammers and sketches showing the proper construction of the foundations, as well as drawings of the machines with all the parts numbered and named.